AUTOMOTIVE INDUSTRIES

LAND — AIR — WATER

AUGUST 1, 1940

Coordination by Wire

(*Continued from page 54*)

private line teletype system, with stations located at the engineering laboratory in Dearborn, the production department and the driveaway office in the Rouge plant and the parts warehouse at Highland Park.

Ford maintains a schedule of daily connections between its TWX stations, ranging from six to nine connections a day, depending upon the volume of traffic. The main office at Dearborn is open from 7:30 a. m. to 10 p. m., five days a week, while one operator is on duty Saturdays. There are 28 teletype machines in the Dearborn office, six of which are commercial telegraph company machines. To expedite traffic, Ford utilizes a 60-page code book which saves time and transmission charges.

Chrysler Corporation began the installation of a teletypewriter communication system in 1932. The Communications Department headquarters are located in the Chrysler plant at Highland Park, Detroit suburb, and operates under R. P. Fohey, corporation secretary. Miss Rose Heffernan is in charge of the system.

The first teletype connection was between Highland Park and the parts depot at Philadelphia, and then this was gradually expanded into the present system. Chrysler maintains Bell System TWX service between Highland Park, Plymouth assembly plants at Evansville, Ind., and Los Angeles, a parts plant at Newcastle, Ind., and the Pekin Wood Products Company, a Chrysler subsidiary at West Helena, Ark. A daily schedule of six to a doxen connections between these points and Highland Park is maintained.

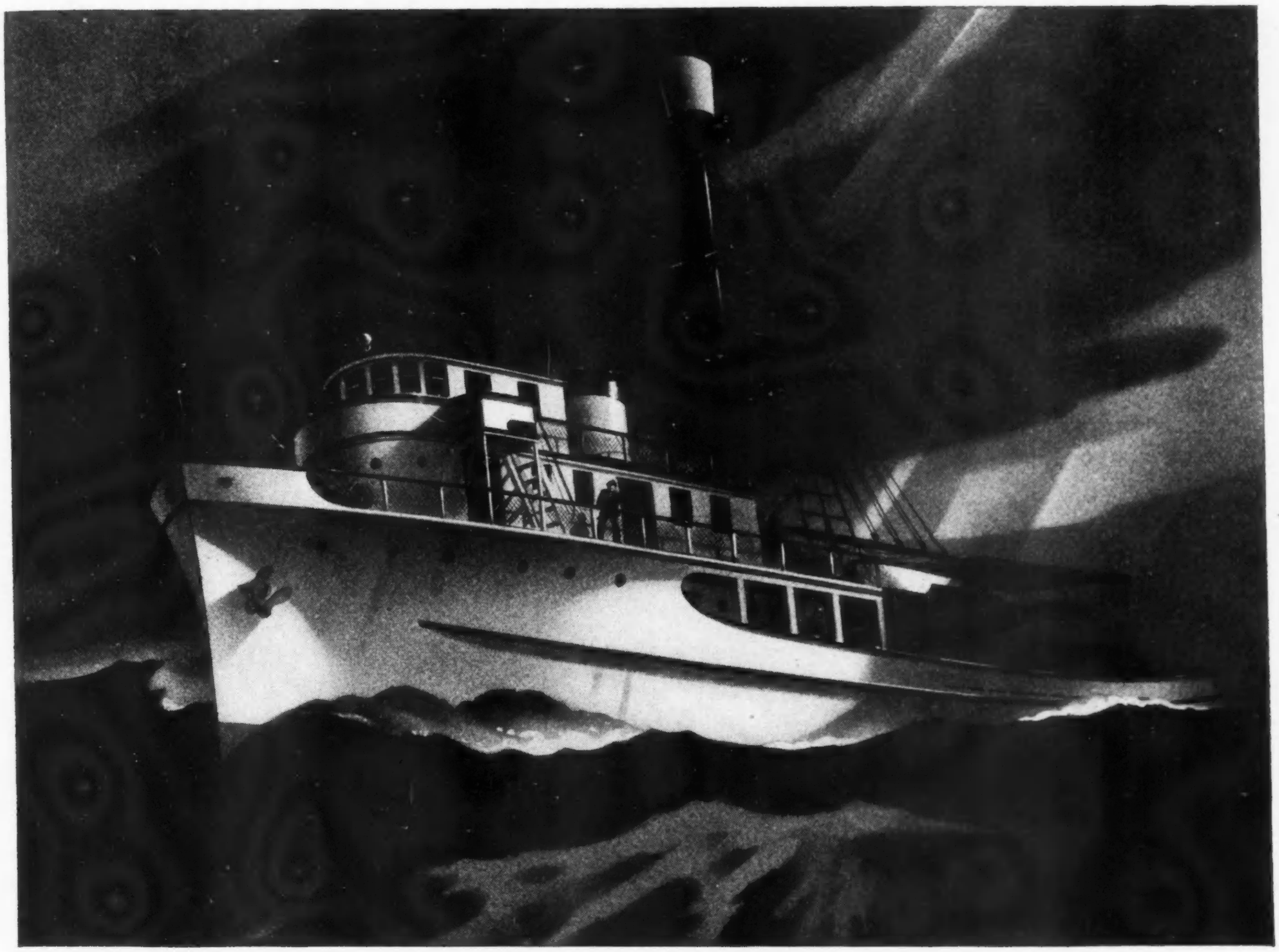
Eight Chrysler Corporation parts depots are connected up by TWX service and relay their messages for Detroit plants through the Chrysler Parts Division at Marysville, Mich., 50 miles north of Detroit. The parts depots on this circuit are the master depots at Philadelphia and Kansas City and the smaller warehouses at Atlanta, Boston, Chicago, Dallas, New York City, Philadelphia, and San Leandro, Cal. Communication between Highland Park and Marysville is maintained by two private line teletype circuits. There also is a separate TWX set-up between the Chrysler export division at Highland Park and its New York office.

Regional offices of the corporation located in cities where there are parts depots also use the TWX service from those points to communicate with the corporation offices at Highland Park. They telephone their messages to the parts depots, from whence the communication goes by teletype to Marysville and thence by private line teletype to Highland Park.

As most of Chrysler's manufacturing operations are centered in the Detroit area, there is another inter-plant system of 11 teletype stations which clears any messages to Marysville or outside points through Highland Park. The Detroit stations are located as follows: three at Dodge Main, two at Chrysler-Jefferson, and one each at DeSoto, Dodge Truck, Plymouth and the Chrysler Canadian plant in Windsor, Ont., and two at the Canadian customs at East Windsor, Ont.

The two machines at the customs office permit the quick clearance of corporation trucks carrying parts and supplies between the Detroit plants and the Canadian factory. The customs invoice of goods is sent by teletype as soon as the truck leaves the Detroit plant. While the truck is enroute across the Detroit River by ferry, the employes in the Chrysler customs office across from the Canadian customs in East Windsor check the teletyped invoice and compute duties. Then, when the truck leaves the ferry in Canada, it is halted only momentarily, eliminating any costly delay of trucks, men or materials.

The Chrysler communication system operates five days a week, from 8:30 a. m. to 5:30 p. m. There are five em-



4140 GOES TO SEA

It is well for all concerned that builders of marine Diesels make performance capacity the primary basis for the selection of materials. Breakdowns at sea or anywhere else are no fun for anyone, including the engine builder.

But the demand for reliability can be met and production costs still kept where they should be. One prominent builder, for example, is doing both by specifying Chromium-Molybdenum (SAE 4140) steel for a number of parts including bolts, wrist-pins, cylinder head studs, gears, tappets and crankshafts.

The fact that this steel can be treated to develop the properties necessary for applications having such different requirements is of value to both builder and user. It simplifies heat treatment and stockroom procedures. And, since simplification makes for uniform quality in the finished parts, it gives added assurance of dependability.

Your own product might benefit through the use of this versatile steel. You will find complete data on this and other molybdenum steels in our book "Molybdenum in Steel," which will be sent free on request.

PRODUCERS OF MOLYBDENUM BRIQUETTES, FERRO-MOLYBDENUM, AND CALCIUM MOLYBDATE

MOLY

Climax Mo-lyb-den-um Company
500 Fifth Avenue · New York City

ployes in the central office — three operators, a messenger girl and a telephone girl. The system handles 13,000 to 15,000 messages per month. The parts division at Marysville has three operators who handle the parts message traffic. Because the volume of traffic is not so heavy at the parts depots and the teletype stations in the plants, the operators at those points are on a part-time basis, having other duties during the time when their station is not in communication with Marysville or Highland Park as per schedule. Chrysler employs both men and women as operators.

In addition to four Bell System teletypewriter machines at Highland Park, there are four telegraph company machines for supplementary messages to points outside the Chrysler inter-plant system.

Other automotive users of private communication systems include Packard Motor Car Company, which has an inter-plant network of 25 teletype machines at Detroit for coordinating production activities as well as TWX service to its larger distributors throughout the United States.

Nash Motor division of Nash-Kelvinator Corporation employs teletype service to handle communications between its Detroit, Grand Rapids and Kenosha, Wis., plants and several sales branches.

International Truck division of International Harvester Company has a private line teletypewriter network tying together its plants and general offices located in the Chicago area and its Indiana plants located in Indianapolis and Fort Wayne. A pneumatic tube system for pick-up and delivery of messages to various parts of the general offices at Chicago is maintained.

Most of the teletypewriter equipment in the automobile plants, as well as private wires, are leased from the telephone companies, which look after all maintenance and repair work.

Ford Receives High Engineering Award

Henry Ford on June 25 received what is regarded as the highest honor that can be conferred upon a mechanical engineer — the James Watt International Medal. It has been awarded to only two men, and Mr. Ford is the only living holder of it.

The medal is given by the Institution of Mechanical Engineers, a British society which cooperates with engineering groups in the 17 industrial nations of the world. The first medal was given to the late Sir John Aspinall in 1936 on the 200th anniversary of James Watt's birth. Others are to be awarded biennually.

The award was presented to Mr. Ford by Alex Dow, former president of the Detroit Edison Co., at a dinner in Detroit.

CALENDAR

Conventions and Meetings

SAE West Coast Transp. & Maintenance Meeting, Seattle ....Aug. 16-17
National Industrial Advertisers Association, Annual Meeting, Detroit, Sept. 18-20
SAE National Tractor Meeting, Milwaukee ....Sept. 24-25
SAE Annual Dinner, New York......Oct. 14
American Society for Metals, Annual Meeting, Cleveland, Ohio....Oct. 21-25
American Welding Society, Annual Meeting, Cleveland ....Oct. 20-25
SAE Nat'l Aircraft Production Meeting, Los Angeles ....Oct. 31-Nov. 2
Aeronautical Chamber of Commerce of America, Inc., Annual Meeting, New York ....Dec. 5
National Association of Manufacturers, Annual Meeting, New York...Dec. 9-13
SAE Annual Meeting, Detroit, Jan. 6-10, 1941
National Automobile Dealers Association, Convention, Pittsburgh, Pa. Jan. 20-23, 1941

Shows at Home and Abroad

National Automobile Show, Grand Central Palace, New York ......Oct. 12-19
Detroit Automobile Show ....Oct. 12-19
Pittsburgh Automobile Show.....Oct. 19-26
National Metal Congress & Exposition. Cleveland, O. ....Oct. 21-25
Chicago Automobile Show....Oct. 26-Nov. 3
Automotive Service Industries Show, Chicago ....Dec. 9-14
Machine & Tool Progress Exhibition, Detroit ....Mar. 24-29, 1941

AUTOMOTIVE INDUSTRIES

LAND — AIR — WATER

AUGUST 1, 1940

AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

Reg. U. S. Pat. Off.
Published Semi-Monthly

Volume 83 — Number 3

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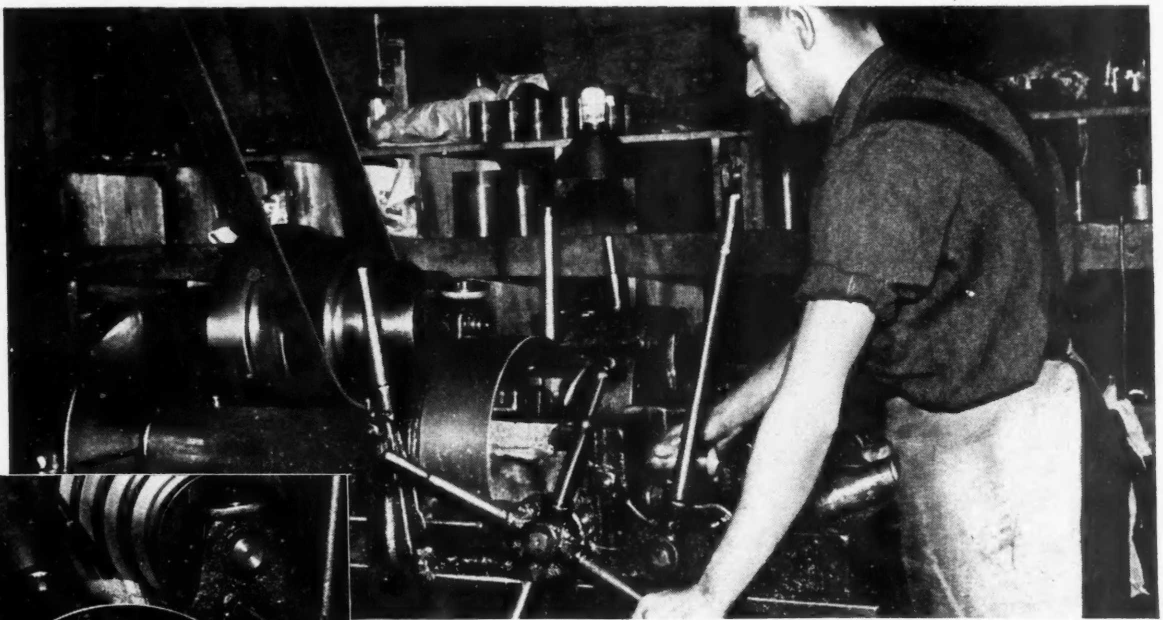
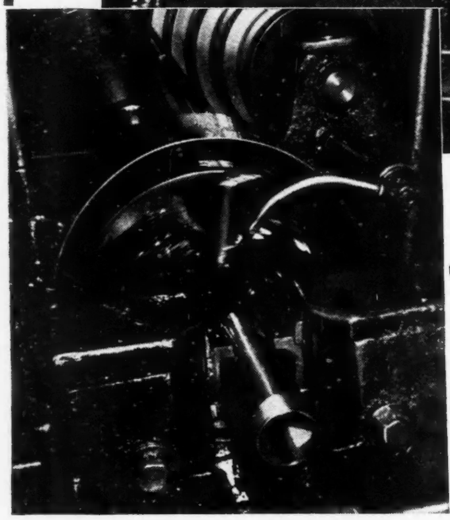
NIPPLE THREADING...

STREAMLINED!



TYPICAL LANDIS THREADING MACHINE at Buffalo Nipple & Machine Co., Buffalo, N. Y., where pipe nipple threading operations have been streamlined by use of *Texaco Sultex Cutting Oil B.*



CLOSE-UP VIEW of pipe nipple in Landis Threading Machine. Greater output, longer chaser life, better sizing and thread form resulted from change-over to *Texaco Sultex Cutting Oil B.*

IN AN EFFORT to improve the general efficiency of their nipple threading operation, the Buffalo Nipple & Machine Company made a big money-saving discovery.

They found that they could increase output, lengthen chaser life, achieve greater accuracy as to thread form, finish and dimension, through the adoption of *TEXACO SULTEX CUTTING OIL B.*

Texaco Sultex Cutting Oil gets down to the very point of the cutting edge, reducing friction, cooling both tool and work and preventing welding of chip to tool.

Trained cutting oil specialists will gladly cooperate in making savings with *Texaco Sultex Cutting and Soluble Oils* in your shop. Phone the nearest of 2300 Texaco warehousing points in the 48 States, or write:

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Texaco Dealers invite you to tune in The Texaco Star Theatre — starring Kenny Baker and Frances Langford — Every Wednesday Night—Columbia Network—9:00 E.D.T., 8:00 E.S.T., 8:00 C.D.T., 7:00 C.S.T., 6:00 M.S.T., 5:00 P.S.T.

TEXACO

REG. T. M.

TEXACO SULTEX

CUTTING AND SOLUBLE OILS

IN THIS ISSUE . . . .

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

Volume 83 August 1, 1940 Number 3

Since 1913 all issues of AUTOMOTIVE INDUSTRIES have been indexed in the *Industrial Arts Index*, which can be consulted in any public library.

CHARLES F. KETTERING, vice-president and director of General Motors Corp., has been named honorary chairman of the American Chemical Society's national meeting which is to be held Sept. 9 to 13 in Detroit. More than 4000 chemists, industrialists, educators and representatives of allied fields will participate in the sessions, at which numerous subjects related to the automotive industry are scheduled for discussion. William Pitt Putnam, president and founder of the Detroit Testing Laboratories, has been named general chairman.

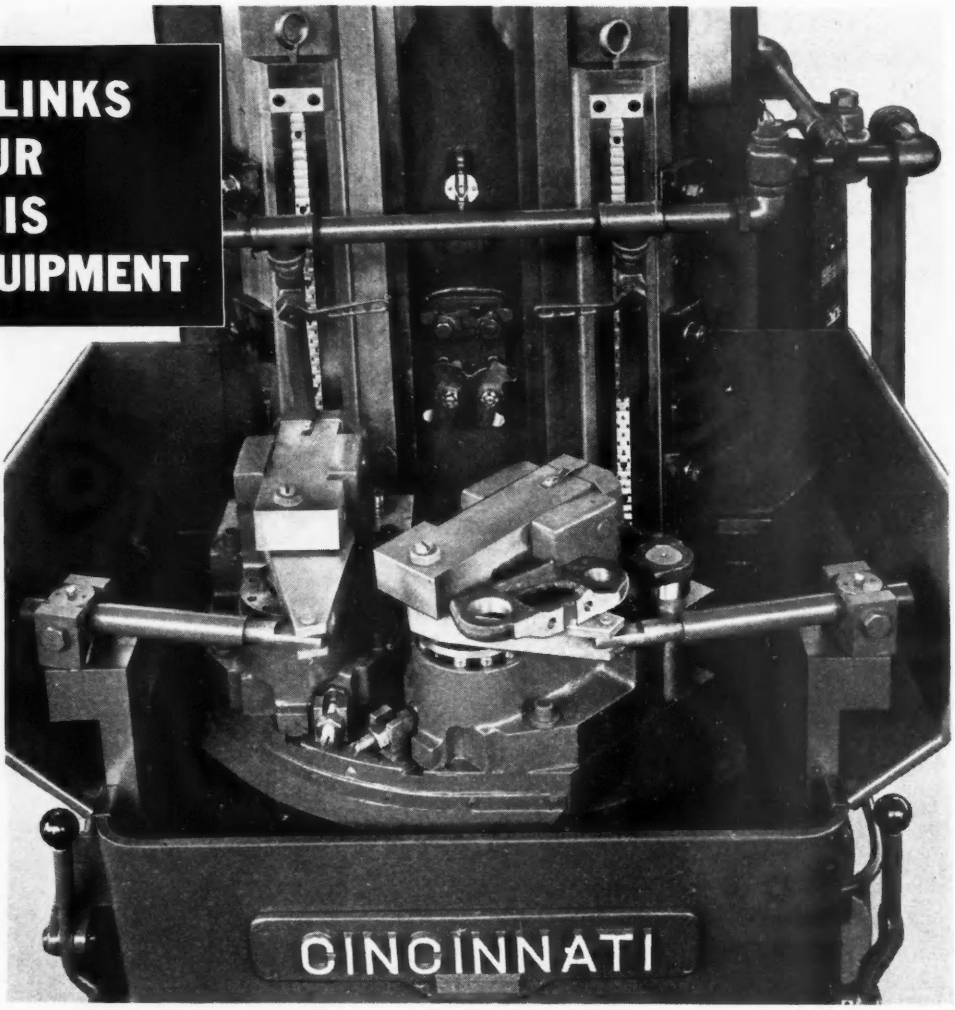
All of the Society's 18 professional divisions will convene during this meeting. The Division of Petroleum Chemistry, of which Dr. Per K. Frolich, director of the chemical laboratories of the Standard Oil Development Co., Elizabeth, N. J., is chairman, will sponsor an extensive symposium on "Petroleum Chemistry's Contribution to the Automotive Field." One group of speakers will discuss the uses of petroleum for power and lubrication; another group will deal with the utilization of petroleum products in coatings, plastics, shock absorbers, and other materials.

The Division of Rubber Chemistry, headed by Ernest B. Curtis of the R. T. Vanderbilt Co., New York City, has arranged a symposium on "Rubber in the Automotive Industry" in addition to a program of papers reporting recent advances in the chemistry of natural and synthetic rubber. W. J. Cameron of the Ford Motor Co., Detroit, will address an evening meeting of the Division. The subject of "Automobile Finishing" is a topic for discussion in another division.

The convention is the fourth to be held by the chemists in Detroit since the Society, founded in New York in 1876, expanded into a national organization 50 years ago. The first Detroit meeting took place in 1894, in conjunction with the American Association for the Advancement of Science. The Society's thirty-eighth meeting was held in Detroit in 1894, and the seventy-fourth, in 1927.

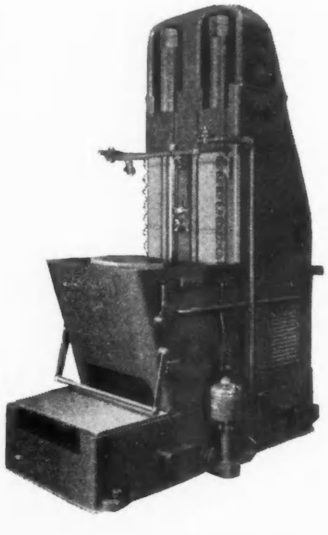
The committee assisting Major Putnam, who was also general chairman of the 1909 and 1927 meetings, includes: Harvey M. Merker, co-chairman; Ralph D. Hummel, Arthur M. Holmes, Leon A. Sweet, and Oliver Kamm of Parke, Davis & Co.; George Calingaert, Harold A. Beatty, and O. Edward Kurt of the Ethyl Gasoline Corp.; Amos W. Oakleaf, William G. Nelson and Sidney M. Cadwell of the United States Rubber Co.; David Segal of Eberbach & Son; Arthur Rautenberg of the Champion Spark Plug Co.; Maurice J. Mulligan and T. A. Boyd of the General Motors Corp.; H. H. Bliss of the Bundy Tubing Co.; and Prof. J. J. Jasper of Wayne University.

430 TRACK LINKS PER HOUR WITH THIS BROACHING EQUIPMENT



TYPICAL of the simpler broaching jobs, these track links present two principal requirements—high production and low costs. The CINCINNATI No. 2-48 Duplex Hydro-Broach Machine selected for the job fills both requirements in several ways.

First, there's the high production of which these machines are capable. With the exclusive CINCINNATI swivel table design, practically continuous cutting is obtained. (One ram cuts while the other ram returns.) Hardened ram ways, automatically lubricated, maintain long life and accuracy. Automatic clamping of fixtures, like those illustrated above, may be easily arranged. Several other features help in *broaching the slots in these track links at a production rate of 430 an hour.*



The complete story of CINCINNATI Duplex Hydro-Broach Machines is given in our new catalog No. M-894. Write for your copy today.

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Manufacturers of
Tool Room and Manufacturing Milling Machines
Surface Broaching Machines   Centertype Grinding Machines   Cutter Sharpening Machines
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AUTOMOTIVE INDUSTRIES

Published on the 1st
and 15th of the month

Vol. 83, No. 3
August 1, 1940

Production Aspects of the National Defense Program

By ALFRED P. SLOAN, JR.*

THE logic of events has recently forced into sharp focus the importance of modern production techniques in making effective a program of national defense. There is now an appreciation of the nation's ability to produce goods and materials. There is a growing realization that the machine and improved technology, which serve to improve our standard of living in normal times, are a prime source of strength as well in periods of emergency. If we would make our preparations for defense effective in war or in peace, machines and a manufacturing technique must back the power of man.

Today, to a degree not even approached in previous history, the development and maintenance of sound defenses depend upon a country's industrial capacity. People, therefore, are turning to industry, with its experience in mass production methods, to do the job. And as the defense program progresses, it may be expected that American manufacturing enterprises will be called upon more and more for production of essential equipment.

Defense, aimed at the preservation of the American way of life, is a primary task at all times. To this task industry has indicated its readiness and willingness to contribute its best efforts based on its productive facilities and its skill and experience. For some time industry has been cooperating with those charged with the responsibility for defense in the execution of "educational orders" for specified material. These orders, although limited in scope, have served to familiarize groups of technicians in many plants with the production techniques required for certain specialized equipment.

Industry Able to Produce

While the demands made upon industry undoubtedly will be great, I believe there can be no question of the potential ability of American industry to produce whatever may be asked of it. The record of our industrial system in producing the great quantities and varieties of useful goods which have brought our standard of living to the highest in the world is, I think, evidence of this ability. Our industrial organization, its efficiencies and techniques are copied throughout the world.

The question is not the potentiality of American industry nor the cooperative and aggressive manner in which the tasks are being faced by all concerned. These are assured. The question solely concerns the essential time necessary to put new types of products into production. That is the great problem. It is not generally understood just how important this time element is in getting ready to produce, on a large scale, equipment of a highly complicated technical nature, which previously has been made only in small quantities more or less by hand, or perhaps not at all.

Careful Preparation Required

Mass or quantity production is not a process that can be started at will. Rather, mass production is a "system" requiring the most painstaking coordination between many different factors and requiring definite procedures involving rigid limitations. These

Careful Preparation Required

Mass or quantity production is not a process that can be started at will. Rather it is a "system" requiring the most painstaking coordination between many different factors and requiring definite procedures involving rigid limitations. These procedures and limitations must be observed if constructive results are to be obtained.

GENERAL

* From a message by Mr. Sloan to stockholders of General Motors.

procedures and limitations must be observed if constructive results are to be obtained.

The essential element in mass production is the period of preparatory work or "make ready." Only after this is completed can mass production, as it is popularly conceived, really begin. In projecting quantity output of any particular product, such preparation involves first finding out what is wanted, then designing the product, selecting materials to suit the purpose, testing the samples and correcting their shortcomings, next determining the most desirable methods of manufacture, the development and construction of tools and machinery adequate to the job, laying out the plant for efficient flow of work and planning the final production process itself. All of which is required before the first finished products are turned out for use.

Even in the automobile industry with its long experience in quantity production and its yearly model change, no substitute has been found for the many months of careful planning and preparation before production can be started on a new design. A year's intensive work is essential.

Production Awaits Design

In a great many cases the intricate devices that characterize modern warfare require plants that are specifically designed and equipped with special machinery to do the particular job. Where existing plants can be utilized, there is usually required a complete rearrangement and re-coordination of plant facilities to allow for installation of a vast quantity of new tools and machines, before production can get under way. It can all be done and there is assurance on every hand that the job will be carried forward most aggressively. But any expectation that miracles can be performed overnight will only lead to confusion in the program and to unnecessary disappointment. The realities must be faced.

Another factor importantly influencing the production of defense material is the difficulty to be experienced in determining upon the kinds of equipment to be produced and their designs. Especially is this true under current conditions. Military technology appears to be undergoing a rapid change—one might almost say a revolution—so far as types and specifications of particular war implements are concerned. Designs considered adequate yesterday are obsoleted today. If, then, new designs become necessary, further delays are inevitable. With the essential technique of quantity production based upon careful preparation after the approval of a design, even minor changes frequently require a rebuilding of tool equipment and a re-planning of the job.

National Defense Comes First

The problem of the defense and preservation of our American way of life is paramount. Nothing else is so important. Defense needs must take first rank in our thoughts and activities. But this does not mean that we can safely ignore or cast aside our manifold and pressing responsibilities in regard to the normal and continuing economic needs of the country. There is no necessity for that. We are not forced here to risk shortages of useful goods. To the extent that efforts are not required in emergency and specialized defense work, it is of the utmost importance that we continue to produce on other vital fronts. Nothing can be gained by dropping suddenly such activities as are essential to our general needs.

In fact, one of the most effective measures of defense is to promote by every means at our command a further strengthening of our internal economy. Continuing intensive efforts in research, the further development of dozens of important new materials and new products, a constantly advanced technology to the end that the economic stability and the buying power of more people may be enhanced — all of these are essential to the over-all task confronting us. To the extent that our business and industrial system can be rebuilt to its former maximum strength and efficiency, to that extent will its resources prove more effective when and as they are needed.

The placing of orders for defense materials on a wider industrial front may in the case of certain specialized lines absorb much of the available capacity. As a whole, however, even the most intensive program now contemplated will, during the coming year, absorb only a small percentage of

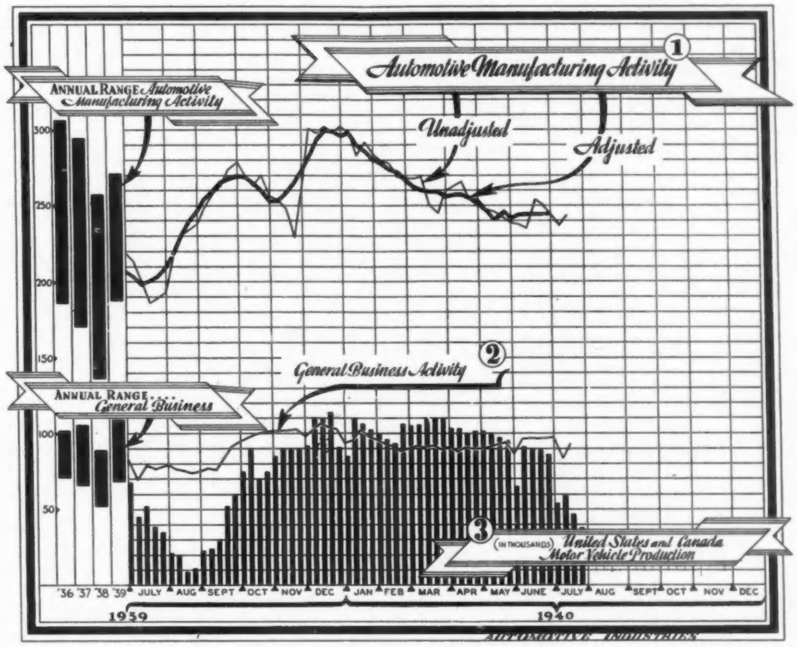
(*Turn to page* 144)

The Brass-Hat Rack

"Sorry, Boss! The paint and trim schedule called for a five window coupe when you came in!"

BUSINESS IN BRIEF

Our own view of automotive production and sales; authoritative interpretation of general conditions



Weekly indexes of automotive general business charted

Production Reflects New Model Activity

PRODUCTION in the automotive industry dipped to its lowest point of the year during July as most of the manufacturers ceased operations on 1940 models by the middle of the month and accelerated the retooling process for the 1941 motor cars. Production for July was estimated at 220,000 units, only slightly in excess of the 218,478 motor cars and trucks turned out in July, 1939.

Output for the week ending July 20 was estimated at 47,000 vehicles. Chevrolet, Dodge, Ford and Willys were the only passenger car plants still in production on 1940 models, while Hudson and Graham were the first to begin turning our the 1941 creations. Production for the succeeding week was expected to slump to 40,000 units and this decline was expected to continue until the middle of August, when 1941 models will begin coming off the line in increasing quantities. June's output of 362,566 motor cars and trucks, according to the official Department of Commerce figures, was 14 per cent greater than June, 1939, and brought the total for the first six months of 1940 to 2,446,458 vehicles. This is 25 per cent higher than production during the first half of 1939.

Retail sales of passenger cars for the first six months of 1940 were estimated by the A.M.A. at 1,849,431 vehicles, a gain of 30.2 per cent over the same period of 1939. Sales of commercial vehicles in the first six months of 1940 totaled 317,787 units, up 19.1 per cent from the 1939 deliveries. June retail deliveries totaled 402,241 passenger cars and trucks, 4 per cent ahead of May and second only to April's 411,277 units as the best 1940 selling month. June showed a gain of 33.2 per cent over 1939.

General Motors' first half year retail sales of 941,821 units were the second best on record, exceeded only by the 964,451 new cars delivered in the first six months of 1936. They were 34.5 per cent ahead of 1939. Chevrolet, leader of the GM parade, turned out its one millionth 1940 model in mid-July. Studebaker had the best first six months since 1928, with sales up 42 per cent over 1939. Chrysler division first half sales were 11 per cent higher than 1937.

The contra-seasonal buying rise in June continued into July. Ford-Mercury sales for the first 10 days of July were the best for any first 10-day period this year, surpassing the same 1939 period by 43 per cent. Chevrolet sales were up 50.5 per cent for the same period.

Reports from 32 states by R. L. Polk & Co. indicate an increase of 29.02 per cent in new passenger car registrations for June over the same month of 1939.

A survey of 500 dealers made by the N.A.D.A. reveals that used car sales increased 13.35 per cent for the first six months of 1940, while the inventory of used cars on hand was up 16.19 per cent as of June 30.

AUTOMOTIVE MANUFACTURING ACTIVITY, after a momentary recovery during the weeks ended June 22 and 29, moved to lower levels in July as indicated by the unadjusted index figures of 245, 236 and 243 registered for the weeks ended July 6, 13 and 20, respectively. The adjusted index leveled off slightly above the 240 mark during this period with figures of 244, 243 and 244 calculated for the weeks ended June 22, 29 and July 6.

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[1] 1923 average = 100; [2] Prepared by Administrative and Research Corp. New York. 1926 = 100; [3] Estimated at the Detroit office of AUTOMOTIVE INDUSTRIES.

BUSINESS ACTIVITY

Clark's Twenty Acres of

An intimate close-up of a portion of the comprehensive heat treatment department in the Jackson plant. The overhead mono-rail in the background transports work from the machine shop inspection depot, and serves as a storage conveyor in the heat-treat department.

By Joseph Geschelin

At the present writing the Clark Equipment Company, one of the most respected names in the automotive field, has four plants all located in the State of Michigan. But its beginnings stem from a very small shop in Chicago, established in 1903, which was moved to Buchanan, Mich., two years later to found the nucleus of the current operation.

It may not be generally known that the company started its activity as the Celfor Tool Co., pioneer producers of forged and twisted drills and reamers. This specialty, which has been pursued without interruption since its inception, constitutes an important branch of the business at Buchanan.

To appreciate fully the scope of the company's contributions as a parts supplier, let us note briefly the plant set-up and product in each of the four divisions. The Buchanan plant, the general headquarters of the organization, comprises seven principal buildings, boasts a floor space of some 12 acres. Among its chief products are—the Celfor line, the Huck riveting process; cast wheels for commercial vehicles; front and rear axles for motor trucks, buses, and industrial equipment; heat-treated forged steel rear axle housings.

Manufacture of automotive axles was begun in 1912, culminated in the development of the heavy duty forged steel rear axle housing which constitutes the backbone of activity at Buchanan.

The Battle Creek plant, covering some three acres of floor space, was erected in 1920, subsequently enlarged to its present capacity. Chief output of this plant is a line of over 61 different models of gasoline-powered industrial trucks, most of these intended for materials handling in manufacturing establishments. Here, too, will be found the railway division of the company, which is credited with making practically all of the trucks used in modern street cars.

The plant at Berrien Springs, covering an area of one and one-half acres, is the most recent establishment of the family. Its principal product is transmissions for motor trucks and buses and for agricultural tractors.

A four-acre plant in Jackson completes the broad scope of the company. This plant, originally operated by the Frost Gear and Forge Co., was acquired in 1928 and subsequently greatly enlarged. Its principal output is the line of transmission gears, differential sets, and ring and pinion sets for Berrien Springs,

Automotive Manufacturing

General perspective in the Frost Gear plant showing the battery of new Gould & Eberhard single spindle gear hobbers at the left, the Fellows line in the background at the right.

Tapping an electric furnace in the steel foundry. The operator at the extreme right is taking a temperature reading of the molten metal with an optical pyrometer.

Buchanan, and Battle Creek. In addition, they make special gear sets for outside customers.

It is our object to provide a perspective of the manufacturing facilities of this progressive organization with special emphasis upon certain outstanding techniques and, in particular, on the role of quality control which is so essential in the manufacture of high grade units intended for heavy duty operation.

The philosophy of decentralization evident here is a matter worthy of special attention, for it permits of all of the unique economies of specialization—not only in the matter of personnel but in techniques and production equipment as well.

Consider for example the Jackson gear plant. It may be appreciated that modern gear manufacture is a highly specialized business, requiring engineers and management executives who have a complete knowledge of current practice in this exacting field. By specialization it has been possible to concentrate the making of all manner of gears in this one plant, providing expertly made and precisely tested gearing for the other divisions. In a similar manner the proprietary techniques and specialized machinery for the production of cast steel wheels and for the fabrication of the heat treated axle housings have been concentrated at Buchanan.

Finally the specialized business of development and manufacture of industrial tractors and railroad equipment is concentrated in Battle Creek where it is effectively insulated from the problems of automotive production.

Materials handling in all divisions has been mechanized in accordance with best modern practice. Here will be found gravity roller conveyors at machine lines, long monorail conveyors for transporting parts to assembly lines, a long monorail at Jackson serving the functions both of transporting and storing gear sets in the heat treating department, hoists, etc. Heavy parts and finished assemblies are transported by Clark

Trucktractors. Latest development along this line is a new system of packaging finished assemblies in large bundles which are transported and tiered in storage and for transit with the new Clark Carloader.

This has served to expedite and render more economical the handling of large assemblies not only in the manufacturing plant but in the customer's establishments as well. The technique has proved particularly valuable in the storing and shipment of such items as truck wheels, front and rear axles, and transmissions.

Now for a brief word concerning the facilities for research and development. In addition to the regular engineering work of design and investigation, each of the plants has special laboratory equipment for the testing of the current product, improvements, and new designs. Thus at Berrien Springs will be found a large four-square axle testing machine with attachments for the testing of transmissions. This machine has sufficient capacity for testing the largest sized transmissions used on heavy duty vehicles.

At the Jackson gear plant there is a test room fitted with a special axle testing machine designed especially for deflection tests, yielding valuable information on the behavior of gearing and shafts under maximum load conditions. Such facilities imply a high level of product quality, give further assurance of complete satisfaction to the customers they serve.

With this bird'seye view of the company as a whole, we can turn our attention to some of the high spots of activity in its automotive divisions.

Buchanan Division

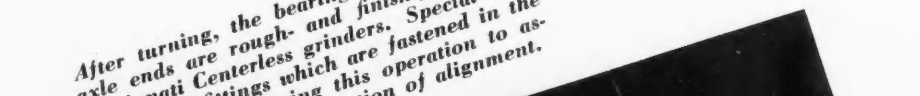
Prize exhibit at the headquarters plant is the rear axle housing department which produces by an exclusive process the heat treated steel housings formed and forged from steel strip. Depending upon the customer's requirements these housings either are completely machined or rough-machined and shipped in that state.

On the premises is the original steel foundry, built for the production of cast steel wheels for commercial vehicles, now engaged in making wheels as well as a variety of parts for other purposes. We are told that this was the first steel foundry in the U. S. to use the electric furnace, and today its entire output of some 300 tons per month is made exclusively by that process.

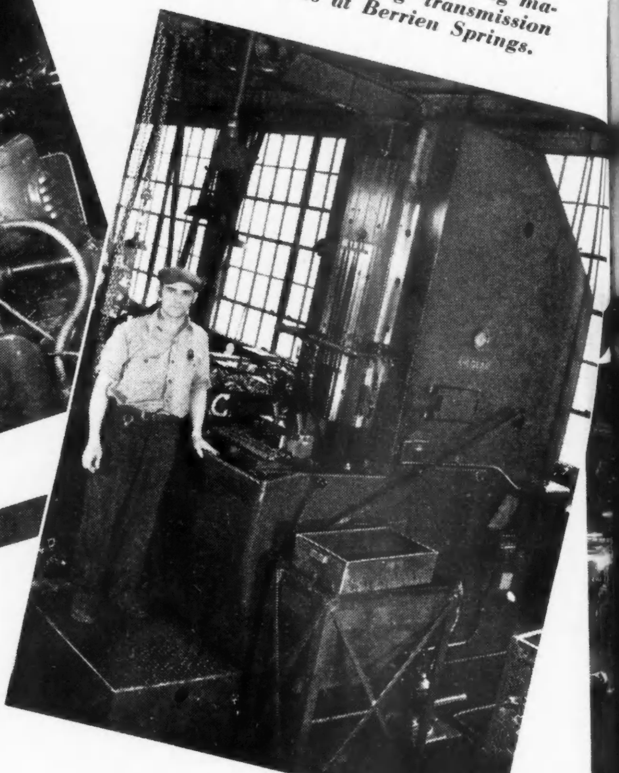
An interesting feature of the foundry is the fact that its raw material consists wholly of remelted steel scrap from the company's own machine shop and axle plant, in the form of press trim stock, rejects, turnings and chips.

As producers of high grade steel castings, the foundry has established high standards of quality control with the responsibility for this control vested in an efficient laboratory department. This is a part of

After turning, the bearing surfaces on the axle ends are rough- and finish-ground on Cincinnati Centerless grinders. Special reinforcement fittings which are fastened in the banjo opening during this operation to assure rigidity and perfection of alignment.



Evidence of modernity is this Oilgear vertical surface broaching machine for broaching transmission shifter forks at Berrien Springs.



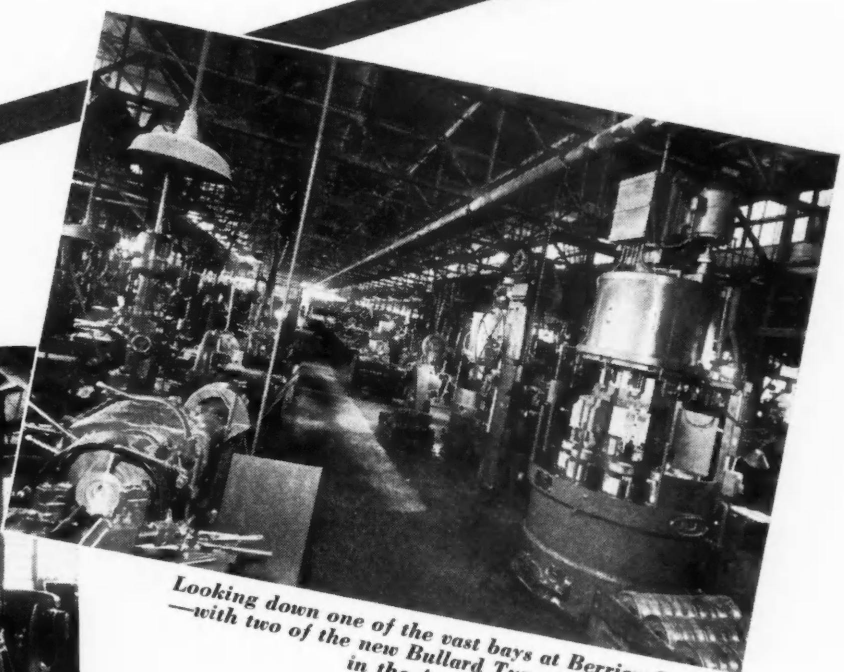
Routing (*Berrien Springs*) Transmission Case

OPERATION AND EQUIPMENT	OPERATION AND EQUIPMENT
PAINT (sealer) Dip tank	**DRILL** and **TAP** filler hole 24-in. Cincinnati drill
MILL both ends 4-spindle Ingersoll milling machine	**DRILL** and **TAP** two drain holes 24-in. Cincinnati drill
MILL differential pads 4-spindle Ingersoll milling machine	**DRILL** both sides B-14 Natco drill
BORE main and countershaft hole Baker Duplex boring machine	**DRILL** both ends B-14 Natco drill
CUT three snap ring grooves 121 Baker drill	**TAP** both sides B-16 Natco drill
REAM main and countershaft holes 28 in. Cincinnati drill	**TAP** both ends B-16 Natco drill
Put in snap ring No. 2 Atlas Arbor press	**MILL** reverse idler bosses 121 Baker drill
BORE differential holes Baker duplex drill with cam feed boring	**DRILL** oil return hole 20-in. Cincinnati drill
REAM differential holes 24-in. Cincinnati drill	**DRILL** reverse idler hole, counterbore dowel hole 10HO Baker drill
Form **REAM** shifter hole 24-in. Cincinnati drill	Line **REAM** reverse idler Hand ream
DRILL radius in stem 20-in. Cincinnati drill	**BRUSH** and wash Dip tank

the central physical and chemical laboratory organization.

The Celfor Division, charter member of the entire group, is said to have been the first producer of drills by forging and twisting. It is a very active part of the company today, making drills from the tiniest to the largest that may be required in a steel mill or railroad shop. All Celfor drills and reamers are made of high-speed steel.

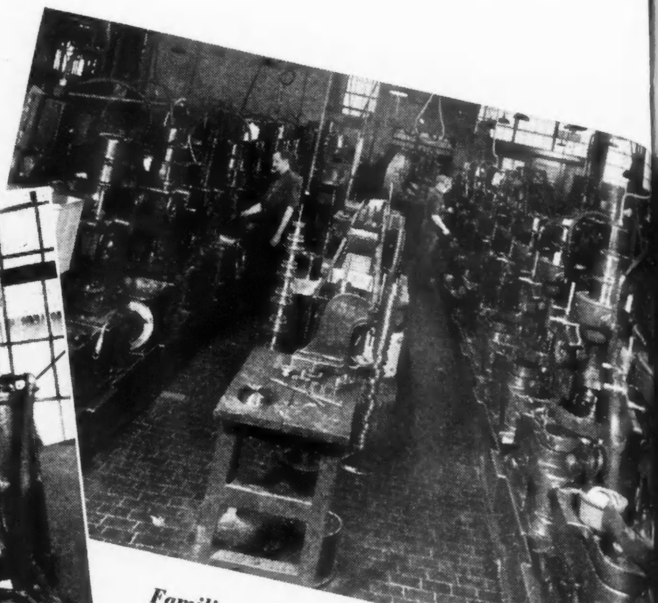
Another of the unique by-product divisions is the Huck rivet department which produces an ingenious multiple-element rivet designed for use in structures where only one side is available for the operation. This type of rivet is particularly suited for box-type chassis frames, for inaccessible sections of any mechanism, for railcars, in trailer fabrication, etc.



Looking down one of the vast bays at Berrien Springs —with two of the new Bullard Type J Mult-Au-Matics in the foreground.

This big Ingersoll mill is arranged for rough- and finish-milling the faces of transmission cases. The fixture holds four cases at a time, permitting the finishing of all four faces in the same setting.

Rear axle housings are heated and drawn in Surface Combustion furnaces, then quenched in a special machine which prevents distortion during quenching. This view shows the exit end of the drawing furnace with the quenching machine directly adjacent at the extreme right.



Familiar high-speed Fellows gear shapers dominate this section of the Frost Gear plant.

The production of these rivets at economical cost levels required the conception of many items of special equipment. Outstanding in this group are three complex, fully automatic hydraulically operated machines which produce the sleeve. Stock is fed into the machine in the form of long bars, automatically upset by a cushioned and floating forging mechanism, then multiple drilled. The drilling operation is performed in a number of steps by presenting the parts in a dial indexing fixture to drills at various stations.

Another battery of special machines is used for the assembly of the heat treated pin, spreader ring, and sleeve. The operation of the assembly machines is automatic, employing an ingenious system of magazine feed which integrates the parts at the assembly station.

The wheel department is a self-contained unit with its own machine shop. Wheels are completely machined, then assembled with brake drums machined in the same department. This assembly, in turn, is chucked in a lathe and the contact surface of the drum rebored concentrically with the bearings. Adjacent to the machine shops is a small department for wheel storage, packaging, and shipment to customers. Too, there is a small building which serves as the axle and wheel warehouse.

Probably the major activity at Buchanan is the axle housing plant which produces the heat treated rear axle housings for motor trucks. Some impression of its capacity may be gained from the fact that the department consumes over 100 tons of strip steel each day. A high-spotting of the steps in the forming of the housing from the strip is given elsewhere.

The machine shops serving the housing department are equipped with many items of metal cutting machinery including, in the main, a large number of Baker single-spindle heavy duty drill presses and many special turning and boring machines made by Baker. One of the largest is a Baker automatic turning and boring machine of double-end type, fitted with a trunnion center fixture which holds six housings at a time.

Axle housing fabrication utilizes some interesting welding techniques, featuring automatic welding heads with wire feeding attachment supplied by General Electric, and Lincoln Electric Tornado welding heads supplied originally for the welding of light axle housing seams. Only two of the automatic Tornado welding heads are used for this purpose at the present time.

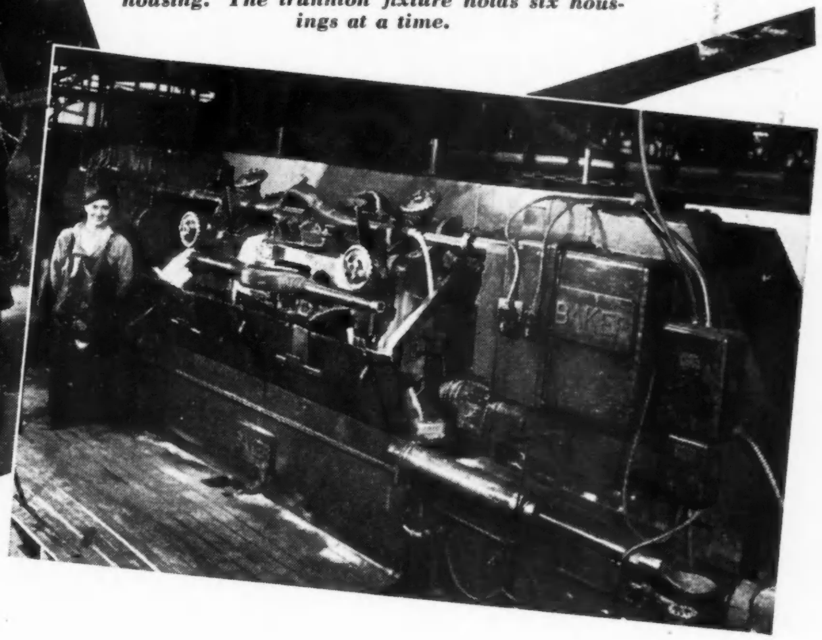
What is said to be one of the most difficult manual welding jobs is that of arc welding reinforcement rings on the inside of the housing to the housing proper. The housing is revolved automatically, the operator striking the arc six times per revolution, joining the near and back edges in one revolution of the work. The entire operation takes one minute of time. This is done with a Lincoln Electric Tornado machine; welding current for this operation is of the order of 600 amp. at an arc voltage of 60 volts.

The weld on the outer edge of the reinforcement ring as well as the welding of the bearing retainer is done with G.E. automatic wire feeding heads.

The welding of the spring pads also is done manually with Lincoln Electric equipment, using ¼ in.—

A number of new individually driven Fay automatic lathes and J & L turret lathes have been installed recently in the Frost Gear division. This shows a battery of Fay lathes set up for turning transmission shafts.

One of the largest pieces of metal cutting equipment at Buchanan is this huge Baker machine for turning and boring both ends of the axle housing. The trunnion fixture holds six housings at a time.



No. 7 Fleetweld rod, with approximately 300 amp. current. The housing is rotated by the operator while he welds completely around the spring pad.

Before machining, the housings are heated and drawn in Surface Combustion Co. furnaces, precisely controlled as to temperature gradient and time of exposure. After heat treatment the housings are quenched in a special machine so designed as to prevent distortion during the operation.

Following quenching, the housings are cleaned by shot blasting in a special machine line built by the American Foundry Equipment Co. This line has two booths on each side of a conveyor, permitting each operator to clean a certain portion of the work while suitably protected from occupational hazards by various modern safety devices such as helmet, gloves, exhaust system, etc.

Supplementing the machine shops mentioned earlier is a sizable department for finish-machining certain of the housings. Here, too, are many items of Baker equipment including some large drills for boring the differential carrier pilot. Double-end Fay automatic

Routing for Reverse Idler Gear

OPERATION AND EQUIPMENT

BROACH hole
No. 4 Oilgear broaching machine
TURN complete
12 in. Fay automatic lathe
ROUGH teeth
Gould and Eberhardt 24 in. Universal gear hobbing machine
SEMI-FINISH teeth
No. 7 Fellows gear shaper
FINISH teeth
Michigan Tool rotary gear shaver
WASH
Niagara washer
TEST
Gleason spur testing machine
Involute **TEST**
Michigan Tool involute checker
FILE

OPERATION AND EQUIPMENT

WASH
Niagara washer
STAMP part numbers
CARBURIZE
Electric Furnace Company electric furnace
QUENCH in oil
DRAW
Homo Electric tempering furnace
INSPECTION
Rockwell hardness tester
GRIND hole
Heald Sizematic grinder
GRIND ends
Blanchard vertical surface grinder
WASH
Niagara washer
Final **INSPECTION**
TEST
Gleason spur testing machine

lathes are used for rough and semi-finish turning of housing ends, this being followed by finish grinding of bearing seats on Cincinnati Centerless grinders.

There is a department for machining carriers and in another section are two Bullard Mult-Au-Matics tooled up for machining transmission drums.

A rather extensive part of the machine shops is devoted to the drive shaft department, producing axle shafts, and shafts for transmissions. Here will be found Sundstrand lathes, Barber-Colman spline hobbing machines, Kearney & Trecker milling machines, and other equipment identified with this form of activity.

The facilities for axle manufacture are complemented by the assembly department which handles both front and rear axles of every description.

In the matter of special tool materials, we note that the principal applications of Carboloy at this plant are in the boring, turning, and facing of the close-grained cast iron brake drums in the wheel department. In addition, Carboloy punches and dies are employed in the forming of the Huck rivets.

Haynes-Stellite J-Metal tools are used for turning, boring and facing operations on cast iron.

Berrian Springs Division

In accordance with the policy of specialization, this plant is primarily a transmission unit. The gears used in transmission building are supplied by the Jackson plant. Berrien Springs boasts a very modern and efficient machine shop plant devoted to the machining of transmission parts which go to make up a gear box.

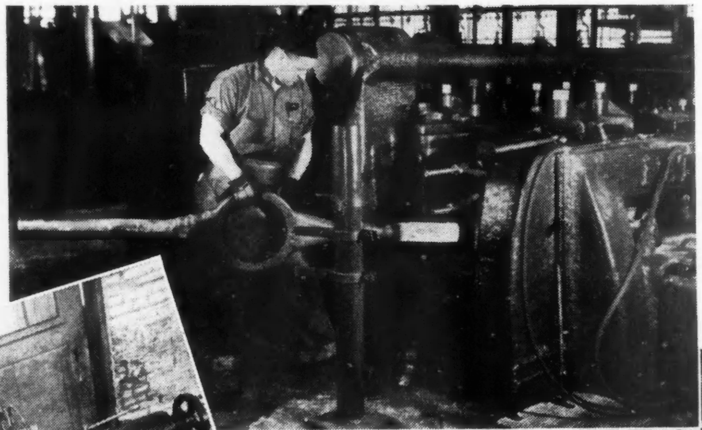
They take transmission building seriously at Berrien Springs, accenting the importance of quality control and attention to "tremendous trifles." Take the matter of receiving and shipping. All materials to and from this plant are handled by motor trucks—with each load protected by covering. Not content with this, they make sure that the product is protected even in the loading and unloading by providing enclosed platforms at both ends of the plant.

Another aspect of quality is found in the procedure of sealing every casting by immersion in a special lacquer bath before the castings are routed to the machine shop. This device, following the sand blasting of each casting, results in castings of exceptionally fine outward appearance. At the other end of the plant, further precautions are taken to preserve the finished units in transit by sealing all openings with plugs or covers, by coating exposed parts with a slushing oil.

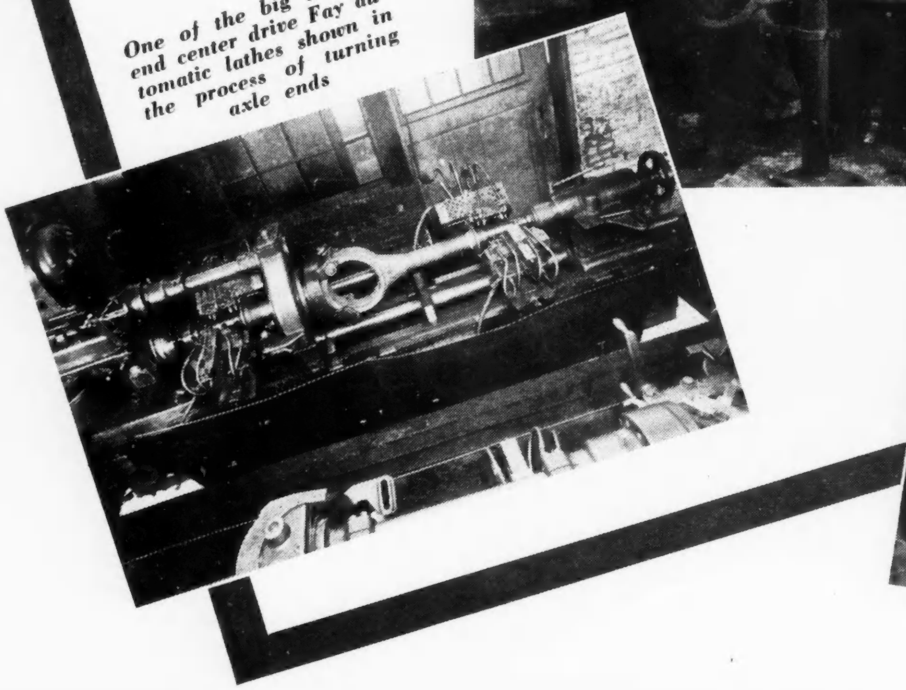
Finally it may be noted that the quality of individual parts in process is effectively controlled by careful inspection in a central inspection department.

Just as the product is handled with meticulous care, so the comfort of the workers has come in for its share of attention. We find, for example, that every milling operation and every metal cutting machine that generates fine metallic dust and dirt has been

Hot forming rear axle housing tube arms in a National Forging machine.



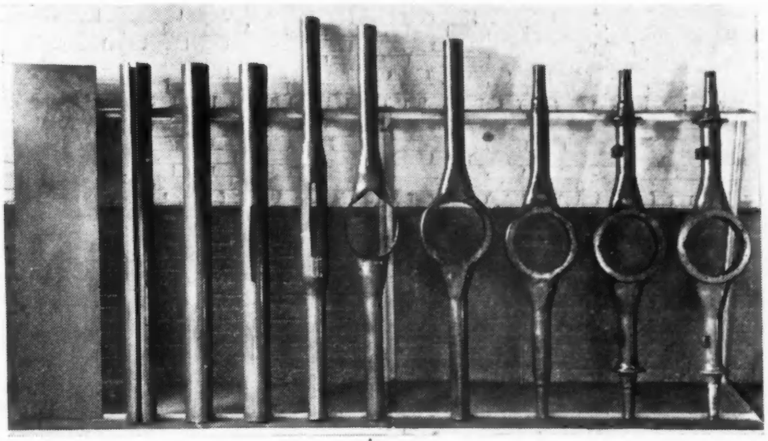
One of the big double-end center drive Fay automatic lathes shown in the process of turning axle ends



One of a battery of special magazine feed assembly machines for producing the Huck rivet assembly.

Routing for Axle Housing Operations

1. Form Tube
2. Weld Tube
3. Straighten Tube
4. Punch Slot in Tube
5. Hot Form Tube Arms
6. Cold Extrude Tube Arms
7. Form Banjo
8. Throat Banjo
9. Flatten Banjo Surface
10. Rough Bore Banjo
11. Upset Housing Ends
12. Weld Reinforcing Rings—either side Banjo
13. Finish Bore Banjo
14. Cut Gear Slot in Banjo
15. Hollow Mill—cut to length—Core Drill
16. Assemble Flanges
17. Weld Flanges
18. Assemble & Weld Spring Pad
19. Fuse Weld Banjo (Junction of Ring & Housing)
20. Heat Treat
21. Sandblast
22. Finish Straighten
23. Ream Core drill hole
24. Inspection



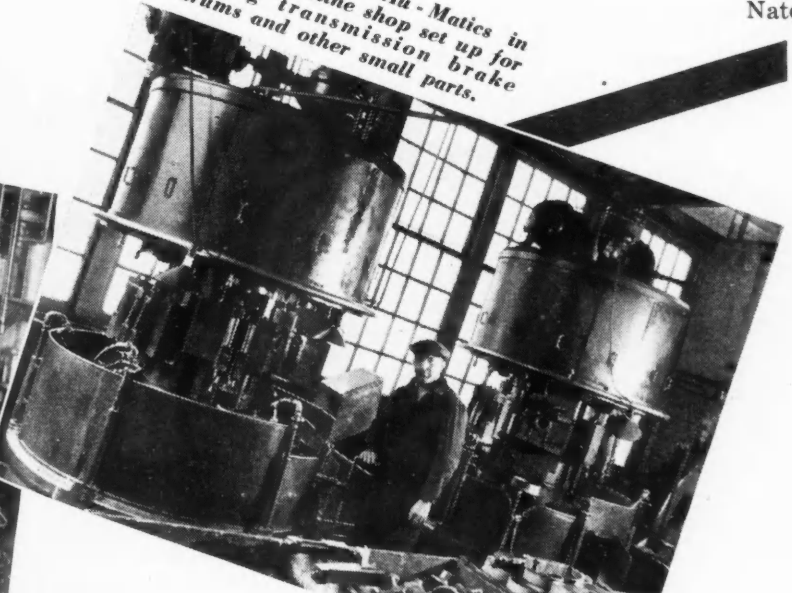
This panel shows the individual steps in the forming of the heat treated rear axle housing, starting with the steel strip at the extreme left. The general sequence of operations is given at the left.

equipped with an efficient dust collector which draws away these objectionable products right at the point of generation. Needless to say, this makes the machine shop a clean and healthy place in which to work.

Currently the transmission plant has about 125 different variation of product on the books. This poses a serious problem of scheduling, makes necessary the use of unit type or universal types of machinery capable of rapid and economical changeover. One of the ways in which the problem has been met is by the use of heavy duty single spindle Baker drills to which are fitted interchangeable Hoefer multiple-spindle heads. Any type of case may be drilled with the efficiency of a special drilling machine simply by fitting the proper head.

Among the more or less universal types of equipment found here are such items as the Bullard V-T-L machines, Cincinnati and Kearney & Trecker milling machines, Cincinnati Centerless grinders, Baker drills. Some of the items in production are required in large quantity and, consequently, justify more specialized equipment. In this category we may mention the Natco multiple-spindle drill fitted with a fixture that holds two cases at a time, and two new Natco tappers. Then there is a battery of the new Bullard, Type J, Multi-Au-Matics which are suitable either for short runs or long runs..

Two Bullard Mult-Au-Matics in Buchanan machine shop set up for machining transmission brake drums and other small parts.



As an example of modernity there is a new Oilgear vertical surface broaching machine, tooled for broaching shifter forks, replacing the previous method of milling. Too, there is an "HO" Baker long stroke drill which is tooled for line boring power take-off housings and cases.

Another instance of flexibility is found in the tooling of the big horizontal case boring machines. These are fitted with multiple spindle boring heads provided with a wide range of locking adjustments for variations in centers and spacing.

A truly striking example of special tooling is the set-up on a Cincinnati Centerless grinder in which the gear shift levers with multiple bends and kinks are ground to a finish in one setting.

In the current set-up all machined parts clear the central inspection, then are routed to the parts stores. Parts are requisitioned from the stores department according to the shipping schedule. They are hung on the monorail conveyor, transported through the Niagara alkaline washing machine, delivered to the final assembly line.

The assembly department, located at the extreme end of the plant convenient to the shipping dock, has two mechanized conveyor lines with sub-assembly stations close at hand. The assembly carriers are of universal type, adjustable for any size and style of transmission. Assembly procedure is of progressive character and in keeping with conventional practice.

It is of interest to note the painstaking care that is taken to assure the precise alignment of major elenents. Despite the fact that every precaution has oeen taken in the machining of the cases and bell housings, before these parts reach the assembly line carrier the two housings are fitted together and the bell housing face trued up on a large lathe. This assures the proper axial alignment of the entire unit when installed.

After assembly the transmissions enter one of two sound test booths, each booth being provided with two electric drives. The gear boxes are installed in the cradle and run at varying speeds in each gear. As the OK'ed units leave the sound booths, the oil is drained and they are made ready for shipment. Incidentally, the special break-in oil used for testing is recovered, centrifuged in DeLaval equipment and filtered for further use.

Before leaving this department, it may be noted that in addition to the two main assembly lines there is a small assembly line for power take-off units.

In this plant, Haynes-Stellite J-Metal inserted blades are used for milling operations on cast iron, while J-Metal tools are used in turning boring, and facing cast iron. Carboloy is employed to a limited extent on miscellaneous machining operations on transmission cases.

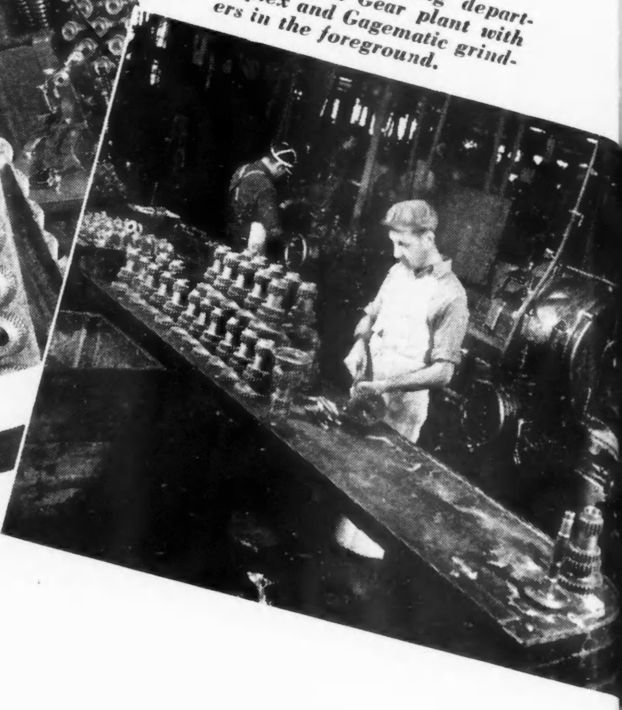
Jackson Division

The Frost Gear division is the gear specialist of the organization, produces gears and differential assemblies for axles; gear sets for railcar drives; transmission gears for Berrien Springs. It has excellent facilities for gear making; it boasts its own forge plant which makes all of the gear blanks, except the very large ring gears for railcar drives.

Quality control predominates here. On the raw materials side of the picture we find scientific laboratory control which reaches back to the steel mills, to the very production of the special alloy bars, and the double check of the finished bars as received at the plant. Forging practice is based on the latest techniques with scientific control of blank temperature, automatic instrument control of annealing and normalizing cycles for finished blanks. The gear division is particularly proud of its heat treating equipment and instrumentation control.

Starting in the forge shop we find the familiar items of equipment such as Erie steam and board hammers, heavy shears for cutting blanks from the bar stock. The blanks are heated to a temperature varying from 2100 deg. Fahr. and upwards, depending

Gear shaving is handled on a battery of five Michigan Tool machines, two of the new cirular cutter machines being just out of the field of the camera at the left. At the extreme right in the background is the new No. 900 Michigan Tool heavy duty rack shaver while at the left are the two standard rack shavers.



A corner of the grinding department in the Frost Gear plant with Heald Duplex and Gagematic grinders in the foreground.

Routing for Spline Shaft

OPERATION AND EQUIPMENT

FINISH TURN threaded end, rough turn pilot bearing end
  2¼ in. 4-spindle Cone automatic
DRILL cotter holes
  24 in. Canedy & Ott bench drill
Center
  Own make centering machine
FINISH TURN
  14 in. standard Fay lathe
HOB CC spline
  Type "A" Barber-Colman hobbing machine
HOB BB spline
  No. 5 Lees-Bradner hobbing machine
HOB AA spline
  No. 5 Lees-Bradner hobbing machine
HOB thread
  6 in. x 20 in. Pratt & Whitney thread miller
FILE
STAMP

OPERATION AND EQUIPMENT

CARBURIZE
  Gas carburizer
DRAW
  Homo Electric draw furnace
DRAW threads
  Lead pot
Wire **BRUSH**
Rockwell and file **INSPECTION**
LAP centers
STRAIGHTEN
  25-ton OilGear press
GRIND side AA splines
  Universal semi-automatic spline grinder
GRIND side BB splines
  Universal semi-automatic spline grinder
GRIND external diameter
  10 x 36 Norton grinder
INSPECTION

upon the nature of the job, the temperature being checked by means of optical pyrometers. Completed forgings are annealed and normalized, finished to satin smoothness by treatment in a large Wheelabrator.

The heat treating department in the forge shop is the very essence of modernity. It comprises a battery of four furnaces—one oil-fired Surface Combustion unit, one propane-fired Surface Combustion unit, two Electric Furnace Co. electric furnaces. Temperature control is achieved automatically by an installation of Micromax recording instruments.

In gear production, Fellows high speed gear shapers are used for spur gears and certain shoulder gears. Gould & Eberhard single-spindle hobbing machines are used for rough- and semi-finish of helical gears. All

(*Turn to page* 140, *please*)

Gleason generator department in the lower level gallery is devoted to production of bevel gears, ring gears, differential gears, and hypoid gear sets.

Another of the big machine lines at Berrien Springs. Natco multiple drills may be seen in the foreground at the right; Baker drill presses and the new Baker deep hole driller at the left.

Body Design Gives Added

THE ADDITIONAL stiffness which may be obtained—without additional cost or weight—by the proper arrangement of structural members in a welded design is likely to be unknown to, or overlooked by, those not familiar with welded construction. Many designers are accustomed to conventional practice, where such stiffness is difficult to incorporate and where loads are considered concentric, torsion being taken care of by other means.

The readiness with which additional torsional rigidity may be obtained was discovered when designing the sub-structure of a garbage dump body, in which the entire design was based upon the torsional rigidity of the composite unit*. The latter included a torsionally-rigid sub-frame in the body and a stiff cross and X member in the chassis, which could transmit this loading to the springs and wheels with a minimum of distortion or side-sway.

Interesting results were obtained in the development of a beam section from standard shapes. The study considered channels as the principal member, with plate welded in three different arrangements: (1), channel running longitudinally, with plate welded at toe and heel of one flange; (2), channel inverted, with flanges downward and plate welded to both heels at web; (3), channel upright, with plate welded to both flanges at the toes. The latter was found the most effective from the standpoint of strength and rigidity for a given weight. It was also more easily fabricated, fitted and welded, and it minimized the cost of production.

The superiority of two channels welded at their toes to form a box section was one of the early discoveries. Further investigation led to the most-effective and ultimate section. This section, shown in Fig. 1, made it possible to obtain a center of gravity located close to the geometrical center of the section. Either design may be generally applied to the load-carrying members of the body, and they can also be tapered (by the necessary provision during welded fabrication) in conformity with the stress distribution, in order to effect an additional reduction in weight. An alternate design, used for lighter loads and cross members, is illustrated in Fig. 2.

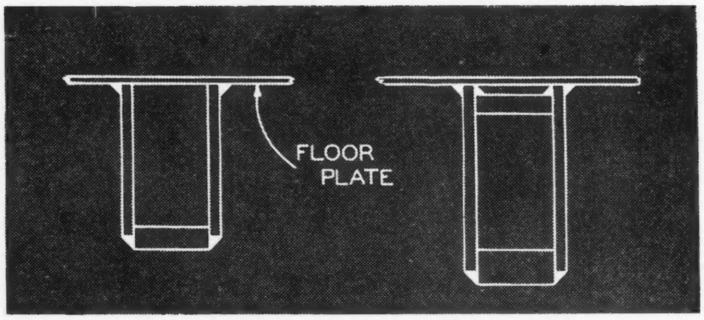


Fig. 1—The fabricated-beam section developed after a thorough study of standard shapes.

The advantages made possible by the fabricated member were incorporated in the design of the body and chassis sub-frame of three hundred 24 cu. yd. garbage bodies of the type illustrated in Fig. 3. The entire body and floor were built of corrosion-resistant high strength steel. According to the original specifications, the doors and tail gate were to be of riveted aluminum construction, but they were later built entirely of arc-welded steel, with the exception of removable parts.

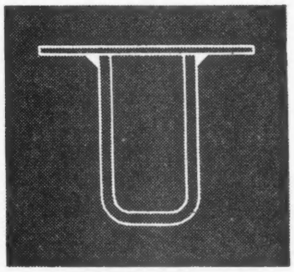


Fig. 2—A modification of the section illustrated in Fig. 1, which is used for lighter loads and cross members.

Specifications called for extremely rigid tests. The body was required to take a load of 15,000 lb., raise and lower it to the full dumping angle, five times, with the center of one wheel 12 in. higher than the other, without injury such as distortion or twisting.

A test was made with a load of 18,000 lb. of steamed cinders, with the trucks on a 6 per cent upgrade. The body did not show the slightest distortion or twist, and came down barely touching the body guides. So satisfactory was the performance that the City of New York adopted the design as standard.

The construction was so rigid that it made no difference whether single- or twin-cylinder hoists were used. It became necessary to design not only the body frame, but also the truck chassis so as to show great resistance to torsion. The X-member of the chassis

* Data and illustrations from award study submitted to the James F. Lincoln Arc Welding Foundation by H. C. Frentzel, chief engineer, The Heil Co., Milwaukee, Wisconsin.

Torsional Rigidity

frame also was completely welded, to give it the same degree of rigidity as the body. It was made of two ship channels, each cut and bent into a "Y" to make one-half of the X. The flanges were welded together at the center, making a box section tied together with plates welded in position. The rear ends were butt-welded to the rear cross member, and the front ends were fitted with plates and welded to the inside of the truck frame.

Ship channels, welded into a box section, enabled the rear cross member to take the vertical stress and resist the horizontal reaction of the hoist load, which acted eccentrically upon it.

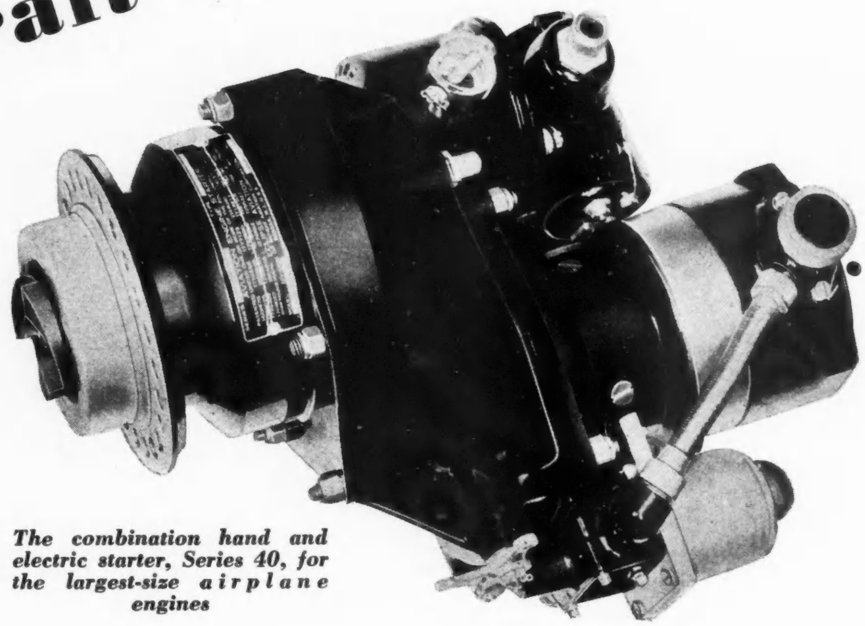
The bar and plate construction illustrated in Fig. 1 permitted a saving of 120 lb. in the longitudinal members alone. Making possible utilization of the floor as part of the beam, the new design also eliminated all coping, as only sheared plates and bars were used, with little waste of material. A further advantage was that it was possible to bend the bars cold. The design reduced the amount of welding and avoided the appearance of many pieces welded together. Another advantage of the design is that the section can be changed as the occasion requires. By the proper welding procedure, the members can be held within 3/16 in. of the required contour over their entire length, without any warping or twisting.

This method of obtaining additional rigidity without increase in cost or weight can be taken advantage of in the design of many mechanical structures and should be given due consideration by those responsible for engineering and design. The illustration in Fig. 3 showing this construction has been somewhat retouched to bring out structural details of the project described in the foregoing article.

Fig. 3 — A 24-cubic yard garbage body incorporating a new design which combines maximum torsional rigidity with minimum cost and weight.

WELDING

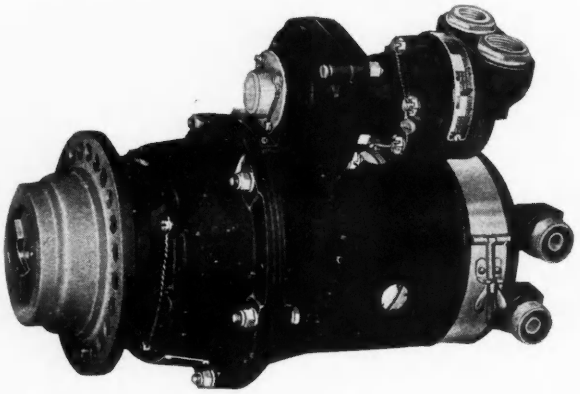
Starters-Feathering Pump for Aircraft Engines



The combination hand and electric starter, Series 40, for the largest-size airplane engines

Two new combination starter units and a combination electric starter and hydraulic feathering pump have been announced by Eclipse Aviation, Bendix, N. J. All are for aircraft engines of large output.

Series 41 direct-cranking electric and inertia starter, for engines of 1500-1800 hp. rating, incorporates all the features of the conventional Eclipse hand and electric inertia starters, and the additional feature that after the kinetic energy of the starter flywheel has been dissipated, cranking of the engine is continued by a heavy-duty integral accelerating motor. Thus the energy stored in the starter flywheel furnishes the heavier "breakaway" torque, and the electric motor has to carry only the lighter load of continuous cranking, which is said to notably reduce the drain on the source of starting current.



Here is a view of the combination direct-cranking electric starter and integrally-mounted hydraulic feathering pump, Series E-160

Series E-160 combination direct-cranking electric starter and integrally mounted hydraulic feathering pump is designed to replace the standard type of E-160 direct-cranking electric starter and separately mounted, motor-driven hydraulic feathering pump. This starter-pump unit, which was primarily developed for use with Hamilton-Standard Hydromatic propellers, incorporates all of the features of the conventional E-160 starter, except that the hand-cranking mechanism usually fitted is replaced by a pump. A reversible motor is used, to permit driving the hydraulic feathering pump when the starter is not in operation. The starter-pump unit, in addition to saving weight by the elimination of an extra motor and some line tubing, provides a compact and light installation, integral with the powerplant and available for operation as required.

Series 40 hand and combination hand and electric inertia starters for engines of 1500-1800 hp. rating are similar in design to the basic types of inertia starters. Energy is stored in a small flywheel by accelerating it to a high speed either manually or electrically, and transmitting the kinetic energy thus stored to the engine crankshaft by means of reduction gearing, a multiple-disk clutch, an engaging mechanism, and driving jaws. The design of this model has been improved and its output has been increased over that of the preceding model.

ENGINE COMPARISONS

and formulae for the dimensions of parts analyzed

By Edward G. Ingram

Empirical formulae for the dimensions of parts, such as crankshaft and valve diameters, frequently are based on the relation to cylinder bore, average or typical figures being obtained from a comparison of a number of engines. Both the method of obtaining such figures and their application to engines under consideration are open to question, due to the fact that stroke-bore ratios vary widely.

As regards applications, if it is stated, for instance, that the head diameter of the intake valve should be, say, 50 per cent of the bore, this would give 2 in. for a 4 by 4-in. cylinder and 1¾ in. for a 3½ by 5¼-in. cylinder, yet the piston displacements of both of these cylinders are the same, and under similar conditions there is no reason for a difference in valve dimensions.

Theoretically, in obtaining and applying such empirical figures, all engines should be changed to the same stroke-bore ratio (mathematically speaking), no matter what ratios are used or are to be used. Any ratio can be chosen, but a ratio of unity is convenient.

If B is the bore; S, the piston stroke, and V, the piston displacement of a cylinder,

$$V = 0.7854\, B^2 S$$

$$\text{If } B = S \quad V = 0.7854\, B^3$$

$$B^3 = \frac{V}{0.7854}$$

$$B = \sqrt[3]{\frac{V}{0.7854}}$$

$$\text{or} \quad B = \sqrt[3]{1.273\, V}$$

which equals the bore of a cylinder of piston displacement V with a stroke-bore ratio of unity. In what follows we will call this bore B', to distinguish it from the actual bore, B.

If d is the diameter of any part under investigation, then

$$\frac{d}{B'} = \frac{d}{\sqrt[3]{1.273\, V}}$$

In Col. 9 of the accompanying table are given the values of the ratio d to

$$\sqrt[3]{1.273\, V},$$

where d is the head diameter of the intake valve, for a number of recent passenger-car engines. The average relation proves to be

$$\frac{d}{\sqrt[3]{1.273\, V}} = 0.442$$

so that

$$d = 0.442\, \sqrt[3]{1.273\, V}$$

To find the valve diameter for a contemplated engine, simply multiply the piston displacement of one cylinder by 1.273, find the cube root of this product from a table or by means of a slide rule, and multiply this figure by 0.442. The formula will, of course, give the same valve diameter in the case of cylinders of the same displacement but different stroke-bore ratios.

The maximum proportional valve diameter for the passenger-car engines listed is found in engine No. 2, for which the coefficient in the valve-diameter formula is 0.506. Exhaust valves usually are made ⅛ or 1/16 in. smaller in diameter than the intake valves, though some manufacturers use the same diameter for both.

The twenty-six passenger-car engines in the table (Page 113) are listed in the order of the piston displacement of one cylinder, starting with the smallest. The stroke-bore ratio, S/B, is given in Col. 4, and will be seen to vary from 1.07 to 1.67. In Col. 10 the effective area, a, of the intake valve when fully open is given. This is not the area of the valve port, but the area of the truncated conical surface of which a line from the small diameter of the valve to the seat is the generatrix. The formula used for determining this area is given in standard textbooks.

The displacement of a cylinder increases as the cube of the linear dimensions, but as cylinders become quite large it is ordinarily impracticable and unnecessary to increase the valve area at such a rate; impracticable because of compression space limitations and valve weight, and unnecessary because large engines, that is, engines with large cylinders, heavy reciprocating parts and consequent high bearing loads cannot be run at such high speeds as engines with small cylinders. Racing engines with multiple valves and reduced factors of safety are in some respects an exception to the foregoing statement, but even with these, greater valve area and greater specific output can be obtained with small cylinders. High r.p.m. and high specific output are inherent characteristics of the small cylinder, and this is one reason why multiple-cylinder engines are favored for passenger-car service.

In Col. 13 is shown the valve area per cubic inch of piston displacement, a/v. Because the range of cylinder sizes is rather narrow in passenger-car engines, and also because of variations in individual designs, there is no pronounced falling off in the ratio of valve area to displacement down this column. Standard car engines are not built with the maximum possible valve area, and since there is leeway, some manufacturers provide larger valves than others.

Near the bottom of the table are listed a few of the more efficient commercial-car and marine engines,

some with much larger cylinders, and here the falling off in the proportion of valve area to displacement becomes apparent. Observe that for engine No. 1, with a cylinder of 17 cu. in., the coefficient is 0.040, while for engine No. 33, with 206 cu. in. displacement, it is only 0.016. The falling off in the number of r.p.m. at maximum brake horsepower as cylinders become really large and the proportions of valve area less, also is clearly indicated, as is the decrease in horsepower per cu. in. with reduced engine speed.

In practice, the valve area tends to be more nearly proportional to the square rather than the cube of the bore, that is, directly proportional to the area of the bore. This is illustrated in Col. 12, in which is given the valve area per sq. in. of bore area, the bore B', rather than the actual bore B, being taken to avoid inaccuracy due to variations in the stroke-bore ratio. This area, A', is equal to $0.7854\ B'^2$. It will be seen that with a few exceptions the figures in this column fluctuate within rather narrow limits. Exceptions are passenger car engine No. 15 and marine engine No. 29, which have abnormally large valve areas for standard engines.

The average valve area per sq. in. of bore area for the twenty-six passenger-car engines listed is

$$\frac{a}{A^1} = 0.118, \quad \text{so that} \quad a = 0.118\ A^1.$$

But since

$$A = 0.7854\ B^2 \quad \text{and} \quad B' = \sqrt[3]{1.273\ V},$$

$$a = 0.118 \times 0.7854 \left(\sqrt[3]{1.273\ V} \right)^2,$$

or the effective valve area is

$$a = 0.093 \left(\sqrt[3]{1.273\ V} \right)^2$$

For the seven commercial-car and marine engines listed the average ratio of valve area to bore area is

$$a = 0.096 \left(\sqrt[3]{1.273\ V} \right)^2,$$

which is not very different.

The average valve-head diameter for these commercial and marine engines is

$$d = 0.460 \sqrt[3]{1.273\ V}$$

which is slightly greater than the corresponding figure for passenger-car engines. This is largely due to the fact that it is not ordinarily practicable to make the lift proportionally as great with large as with small valves, so that a greater diameter must be used.

In view of the foregoing remarks, it is interesting to note the following:

Roughly speaking, one cylinder of engine No. 32 has about twice the linear dimensions of engine No. 2; about eight times the piston displacement, 166.3 against 22.3 cu. in.; close to four times the valve area, 3.703 against 0.956 sq. in. (that is, the proportion of valve area to bore area is 0.132 for both engines), and about one-half the valve area per cu. in. of displacement, 0.022 against 0.043 sq. in.; the former engine runs a little over one-half the maximum r.p.m. of the latter, 2100 against 3900, and develops somewhat over one-half the maximum horsepower per cu. in. of displacement, 0.266 against 0.412.

Next to the bottom of the table are given the specifications of a marine racing engine with L-head cylinders of over 105 cu. in. displacement each. This engine has unusually large valves, with a lift of over ½ in., copper cylinder heads, a compression ratio of 7.80, and dual carburetors, and it develops 0.414 hp. per cu. in. at 2850 r.p.m., which is an unusually high specific output for cylinders of this size. Note that the valve area per sq. in. of bore area is about 50 per cent greater than for passenger-car engines, which makes the proportion of valve area to displacement comparable. Due to the high valve lift and specialized design, this engine does not "idle" well below 1000 r.p.m.

Last in the table are listed the specifications of a special racing-car engine with 65.5 cu. in. cylinders, dual intake and exhaust valves, and a compression ratio of 13.50 to one. Note that the total intake valve area per sq. in. of bore area and the horsepower per cu. in. of displacement are about twice as great as the figures for passenger-car engines.

In Col. 11 is given what is commonly termed the "mean gas velocity," G, in feet per minute, through the intake valve at maximum horsepower, derived from the usual textbook formula

$$G = P \frac{A}{a},$$

where P is the mean gas speed; A, the area of the bore, and a, the effective area of the intake valve when fully open.

Viewed from the standpoint of what actually happens in the cylinder, the expression "mean gas velocity" has little meaning, for the valve is not fully open throughout the intake stroke, but only during a small proportion of it, and in addition a cylinder never takes in a full charge at maximum output, as is assumed in the formula.

Since the valve is either opening or closing during most of the intake stroke, the average area throughout this period really should be taken, and this would vary with the valve timing and the form of cam used. Moreover, it has been found that the gas flow through a poppet valve under a given head will vary under different conditions. Generally speaking, a large valve with a small lift will pass a greater weight of charge, under the same conditions, than a small valve with such a lift that the maximum area of opening is the same. Such a small change as streamlining the under side of the valve may improve the gas flow. Also, most valves in L-head engines are much restricted around a considerable portion of their circumference in order not to adversely affect combustion-chamber design.

Photographs of the gas flow through valves in pockets indicate that to avoid material restriction, the width of the annulus around the valve circumference should be from one and one-half to two times the lift, but provision of this width is impracticable.

While the amount of valve area provided undoubtedly is the main factor limiting the r.p.m. in engines otherwise designed for maximum output, such as racing engines, a study of the table will show that with standard engines other factors are involved. Sev-

Special Engine Data

Engine No.	Col. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						INTAKE VALVES															CRANKSHAFT		
	PASSENGER CAR ENGINES	No. of Cylinders	Piston Displacement of one Cylinder V	Bore and Stroke	Stroke-Bore Ratio S/B	Arrangement	Seat Angle	Lift h	Head Diameter d	Ratio of Head Diam. to Bore, B'*	Effective Area a	Mean Gas. Speed in Ft. Per Min at Max. H.P. G	Valve Area Per Sq. In. of Bore Area, A'** a/A'	Valve Area Per Cu. In. of Piston Disp. a/V	R.P.M. at Max. Brake H.P.	H.P. Per Cu. In. of Piston Disp. H.P./V	Max. Torque (Lb. Ft.) Per Cu. In. Piston Disp. T/V	R.P.M. at Max. Torque	Compression Ratio	Area of Carburetor Opening	Rear Bear. Dia. for 4 and 5 Bear. Vertical Cyl. Eng. d	Ratio of Diam. to Bore, B'*	Ratio of Connecting-Rod Length to Stroke r/S
1	Ford	8	17.0	2.6x3.2	1.23	L	45	0.251	1.281	0.458	0.680	14581	0.110	0.040	3500	0.441	0.691	2500	6.60	0.515 Two Carb.	.....	.....	1.94
2	Lincoln Zephyr	12	22.3	2¾x3¾	1.36	L	45	0.292	1.537	0.506	0.956	15134	0.132	0.043	3900	0.412	0.696	2000	6.70	0.785	.....	.....	1.97
3	Studebaker	6	27.4	3 x3⅞	1.29	L	45	0.312	1.344	0.411	0.891	20491	0.106	0.033	4000	0.474	0.779	1600	6.50	1.227	2.437	0.745	1.66
4	Ford	8	27.6	3 1/16x3¾	1.22	L	45	0.292	1.537	0.470	0.956	18299	0.114	0.035	3800	0.385	0.670	2200	6.15	0.737	.....	.....	1.87
5	Hudson	6	29.2	3 x4⅛	1.37	L	45	0.343	1.375	0.413	1.085	17902	0.125	0.037	4000	0.526	0.789	1400	7.00	1.227	.....	.....	2.09
6	Buick	8	31.0	3 3/32x4⅛	1.33	I	45	0.348	1.531	0.450	1.175	14910	0.129	0.038	3400	0.431	0.819	2000	6.10	0.785	2.526	0.754	1.85
7	Pontiac	8	31.1	3¼x3¾	1.16	L	30	0.297	1.469	0.431	1.065	18010	0.117	0.034	3700	0.402	0.703	1600	6.50	1.227	2.500	0.733	2.02
8	Studebaker	8	31.3	3 1/16x4¼	1.39	L	45	0.344	1.406	0.411	1.037	15982	0.113	0.033	3600	0.439	0.780	2000	6.00	0.785	.....	.....	2.00
9	Hudson	8	31.8	3 x4½	1.59	L	45	0.343	1.500	0.437	1.180	18868	0.128	0.037	4200	0.504	0.740	1800	6.50	1.227	2.406	0.701	1.82
10	Oldsmobile	8	32.1	3¼x3⅞	1.19	L	30	0.312	1.562	0.453	1.194	16152	0.128	0.037	3600	0.428	0.778	2000	6.20	1.227	2.687	0.779	2.02
11	Plymouth	6	33.6	3⅛x4⅜	1.52	L	45	0.312	1.469	0.420	0.979	20554	0.102	0.029	3600	0.417	0.765	1200	6.70	1.767	2.250	0.643	1.81
12	Hudson	6	35.3	3 x5	1.67	L	45	0.343	1.375	0.387	1.085	21698	0.110	0.031	4000	0.481	0.792	1200	6.50	0.785	.....	.....	1.64
13	Packard	8	35.3	3¼x4¼	1.31	L	30	0.318	1.484	0.418	1.268	16677	0.128	0.036	3600	0.426	0.798	1700	6.41	0.785	2.750	0.775	1.81
14	Chevrolet	6	36.1	3½x3¾	1.07	I	30	0.312	1.641	0.458	1.204	16979	0.120	0.033	3400	0.393	0.785	1200	6.25	1.227	2.781	0.777	1.82
15	Cord	8	36.1	3½x3¾	1.07	L	30	0.344	1.719	0.480	1.426	15187	0.142	0.040	3600	0.399	0.762	1700	6.32	0.785	.....	.....	2.17
16	Dodge	6	36.3	3¼x4⅜	1.35	L	45	0.312	1.469	0.410	0.979	22234	0.097	0.027	3600	0.400	0.763	1200	6.50	1.485	2.500	0.698	1.82
17	Graham Super Chg'd.	6	36.3	3¼x4⅜	1.35	L	30	0.312	1.516	0.424	1.212	19967	0.120	0.033	4000	0.551	0.831	2400	6.65	1.485	2.250	0.628	1.60
18	Graham	6	36.3	3¼x4⅜	1.35	L	30	0.312	1.516	0.424	1.212	18967	0.120	0.033	3800	0.442	0.780	1600	6.65	1.485	2.250	0.628	1.60
19	Pontiac	6	37.1	3 7/16x4	1.16	L	30	0.297	1.594	0.443	1.147	18987	0.113	0.031	3520	0.391	0.736	1400	6.50	1.227	2.500	0.694	1.89
20	De Soto	6	38.0	3⅜x4¼	1.26	L	45	0.344	1.656	0.455	1.252	18232	0.120	0.033	3600	0.438	0.772	1200	6.50	1.767	2.500	0.687	1.83
21	Oldsmobile	6	38.3	3 7/16x4⅛	1.20	L	30	0.312	1.562	0.427	1.194	18182	0.113	0.031	3400	0.414	0.784	1400	6.10	1.227	2.687	0.734	1.89
22	Nash Lafayette	6	39.1	3⅜x4⅜	1.30	L	45	0.312	1.656	0.450	1.121	21988	0.105	0.029	3400	0.422	0.762	1200	6.30	0.785	.....	.....	1.89
23	Nash	6	39.1	3⅜x4⅜	1.30	I	45	0.347	1.750	0.476	1.276	19311	0.120	0.033	3400	0.447	0.809	1050	6.00	1.227	.....	.....	1.89
24	Buick	8	40.0	3 7/16x4 5/16	1.26	I	45	0.347	1.781	0.480	1.342	17902	0.124	0.034	3600	0.440	0.840	2000	6.25	1.227	2.812	0.758	1.91
25	Packard	6	40.8	3½x4¼	1.24	L	30	0.318	1.531	0.410	1.318	16549	0.121	0.032	3200	0.408	0.796	1200	6.39	1.227	2.750	0.737	1.81
26	Cadillac	8	43.2	3½x4½	1.29	L	45	0.355	1.880	0.495	1.363	15750	0.120	0.032	3400	0.404	0.780	1700	6.70	1.227	.....	.....	2.50
	COMMERCIAL AND MARINE ENGINES																						
27	White, Truck	6	88.2	4⅝x5¼	1.14	I	45	0.381	1.130	0.442	1.743	20244	0.115	0.020	2400	0.253	0.737	1000	50.0	2.405	.....	.....	2.00
28	Buda, Truck, Bus	6	106.3	4¾x6	1.26	L	30	0.375	2.500	0.486	2.551	13900	0.122	0.024	2000	0.210	0.635	1000	4.75	2.405	3.000	0.584	2.21
29	Hall-Scott, Truck, Bus.	6	117.8	5 x6	1.20	I	30	0.482	2.620	0.493	3.379	12201	0.152	0.029	2100	0.256	0.696	1200	4.90	3.142	.....	.....	1.83
30	Hercules, Truck, Bus.	6	117.8	5 x6	1.20	L	30	0.468	2.430	0.458	2.957	13280	0.133	0.025	2000	0.209	0.644	900	4.50	3.142	.....	.....	2.00
31	Waukesha, Truck	6	130.8	5½x5½	1.00	I	45	0.500	2.210	0.402	2.500	14190	0.105	0.019	1800	0.197	0.723	700	4.80	2.405	.....	.....	2.14
32	Hall-Scott, Truck, Bus.	6	166.3	5½x7	1.27	I	30	0.484	2.870	0.481	3.703	15729	0.132	0.022	2100	0.266	0.751	1400	5.07	3.142	.....	.....	1.57
33	Buda, Truck	6	206.0	6 x7¼	1.21	L	30	0.438	2.930	0.458	3.194	13496	0.099	0.016	1400	0.153	0.659	700	4.70	3.142	3.500	0.547	2.10
	MARINE RACING ENGINE																						
34	Chris-Craft	8	105.7	5 1/16x5¼	1.04	L	30	0.531	2.650	0.518	3.841	13069	0.186	0.036	2850	0.414	.....	.....	7.80	Two Carb. Each 3.142	.....	.....	2.14
	RACING CAR ENGINE																						
35	Offenhauser	4	65.5	4¼x4⅝	1.09	I	35	0.390	Two Valves 1.750	Ratio Comb. Dia. 0.801	Comb. Area 3.505	15609	0.234	0.054	5000	0.897	.....	.....	13.0	.....	.....	.....	.....

*$B' = \sqrt[3]{1.273\,V}$, or the bore of a cylinder of equivalent piston displacement, V, with a stroke-bore ratio of unity.
**A' = Area of bore when $S/B = 1$, or $0.7854\,B'^2$.

All ratios are related to unity, for example, a stroke-bore ratio of 1.23 means 1.23 to 1.
All dimensions are in inches (linear, square or cubic).

eral engines with more than the average valve area, some with overhead valves, do not develop as high r.p.m. or as high specific output as certain others with less valve area. The somewhat variable requirements of high torque at certain engine speeds, better fuel economy and easy starting necessitate different valve timing, smaller carburetors and more restricted manifold passages than would be used if high maximum power output were the sole objective. Resistance to gas flow elsewhere is indicated by the fact that the gas velocity through valves of about the same diameter and lift varies considerably. It will be seen that in some cases the gas speed reaches over 22,000 ft. per minute. To further facilitate engine comparisons, the area of the carburetor opening is given in the table, and also the maximum torque per cu. in. of piston displacement.

High maximum torque per cu. in. attained at high r.p.m. will be found in the case of two overhead-valve engines and in supercharged engine No. 17, where maintenance of the charge by forced induction gives a rising torque curve up to 2400 r.p.m. Compare the latter with engine No. 18, the same engine without forced induction. Several other engines, however, approach the specific output of the supercharged engine.

Col. 21 shows the ratio of the rear main-bearing diameter, d, to the bore B', passenger-car four-bearing six-cylinder and five-bearing eight-cylinder engines. The average for six-cylinder engines is

$$d_1 = 0.70 \sqrt[3]{1.273\ V},$$

and for eight cylinder engines,

$$d_1 = 0.75 \sqrt[3]{1.273\ V}$$

The last column shows the ratio of connecting rod length to stroke, r/s. For the passenger-car vertical engines listed the average is 1.84; for V-type engines, 2.09, and for all passenger-car engines, 1.89.

In closing it may be pointed out that engines having different stroke-bore ratios should not be compared on the basis of equal piston speed. Two engines with cylinders of the same piston displacement, identical valve area and similar design throughout will tend to develop the same horsepower at the same number of r.p.m., but the piston speeds will differ if the stroke-bore ratios are different. A comparison at equal piston speed would give the impression that one engine was more efficient than the other. Also, with cylinders of the same stroke-bore ratio but different displacement, as 3 by 3-in. and 5 by 5-in., at the same r.p.m. the piston speeds will be different. In engine comparisons of this kind the piston speed is a side issue, except when considering such matters as relative piston wear.

The writer is indebted to Assistant Engineer B. Read, Wilcox-Rich Division, Eaton Mfg. Co., for certain references to the gas flow through poppet valves; and to the Chris-Craft Corp. and Offenhauser Engineering Co. for data on special racing engines.

WITH one assumption made in Mr. Ingram's article we cannot quite agree, viz., that the effective valve diameter should be made proportional to the cube root of the displacement of the individual cylinder, rather than to the cylinder bore. It is true that if all engines of a given cylinder displacement were to have the same peaking speed, they would require valve diameters proportional to the cube root of the displacement, but usually one expects a long-stroke engine to turn over at a somewhat lower speed than a short-stroke one of the same cylinder size. Besides, while there is no absolute limit to the size of valve that can be used with an engine of a given bore, if it is desired—as it usually is—that the distance between cylinder axes shall be the minimum which permits of carrying the water jacket all around the barrels, the designer will want to use the maximum valve diameter which he can conveniently accommodate, whether the engine is of long or short stroke, and this is directly proportional to the cylinder bore. This statement might seem to be at variance with the fact that not all engines of a given bore have valves of the same diameter. The explanation, of course, is that there are other factors besides the bore which restrict the maximum practical valve diameter. Some designers, for instance, may consider it necessary to carry the cooling jacket all around the valve seats, while others will omit it between seats.

That there is a slightly better correlation between valve diameter and cylinder bore than between the former and the cube root of the cylinder displacement is borne out by an analysis of the dimensions for passenger cars given in Mr. Ingram's table, which shows that the mean deviation from the average valve diameter-bore ratio is slightly less than 5 per cent, while that from the average valve diameter-equivalent bore ratio is slightly more than 5.5 per cent.

Fundamental Aspects of Boundary Lubrication

THE fundamental aspects of boundary lubrication are discussed in a paper that has been presented before the Society of Automotive Engineers by H. Blok of the Delft Laboratory of Royal Dutch Shell. Boundary lubrication exists when there is direct metallic contact over a part of the bearing surface. In his paper, Mr. Blok subdivides boundary lubrication into four classes, the determining factors being the mean (sometimes apparent) pressure in the region of contact and the mean temperature in the surfaces of actual contact. This leads to four types of boundary lubrication, as follows:

1. Low-pressure and low-temperature boundary lubrication, referred to briefly as "mild boundary lubrication."
2. Low-pressure, high-temperature boundary lubrication, briefly described as "high-temperature boundary lubrication."
3. High-pressure, low-temperature boundary lubrication, briefly described as high-pressure boundary lubrication, and finally,
4. High-temperature, high-pressure boundary lubrication, briefly "extreme boundary lubrication."

In any particular case, whether the mean temperature or the mean pressure must be considered low or high depends not only on their absolute magnitudes but also on the materials of the rubbing surfaces. It has been impossible so far to establish definite limiting values, but the differences are very characteristic. Type 4, for which the expression "extreme boundary lubrication" is suggested, has been known heretofore as EP or extreme-pressure lubrication. The author suggests that such terms as "oiliness," "film strength," etc., be discarded, as they can be defined only very vaguely, hence their use is apt to give rise to misunderstanding.

Conditions characteristic of the four different types of boundary lubrication were discussed in the paper in some detail, and it was even hinted that a further subdivision of types might be called for.

A PATENT has been granted in Great Britain to L. Gardner & Sons, Ltd., for an automatic injection-timing device for Diesel engines in which the pressure generated by an engine-driven water pump is applied to a diaphragm, and motion of the diaphragm shifts the fuel-injection-pump drive gear on helical splines.

Production Lines . . .

Quality Control

Leading exponent of the use of statistical methods in achieving quality control at economic levels of cost, W. A. Shewhart, Bell Telephone Laboratories, recently discussed the subject in a series of four lectures before The Graduate School of The Department of Agriculture, Washington, D. C. The subject matter of the lectures, edited and annotated, has been published in a book entitled, "Statistical Method from the Viewpoint of Quality Control," issued by The Graduate School. It is of more than passing interest to note that Dr. Shewhart has stressed the practical applications of the statistical theory and method, implying that the mathematical analysis can be employed as a tool to guide the practical man. "It is significant that mass production plus statistical techniques when combined in the operation of statistical control provide a continuing, self-correcting process of making the most efficient use of raw materials and fabrication process." Scanning briefly the content of this important contribution to mass production control, we find the book divided into four main chapters—the first, concerned with a description of the concept of statistical control, the operation of such control, and the judgment of control; the second, concerned with the practical problems of establishing tolerance limits that make possible the most efficient use of raw materials; the third, describing the matter of providing an effective running quality report; the fourth, introducing the concepts of precision and accuracy, discusses the simplest type of specification of a state of statistical control of a single quality characteristic.

We are confident that this introduction of the scientific approach to quality control will impel the management of mass production plants of the industry to investigate the practical applications of this valuable tool.

Mass Methods

Recent swing through New England brought us face to face with the striking expansion of machine tool facilities designed to meet the exceptional demand for machine tool equipment. This has brought about a marked increase in engineering development and an even greater expansion of engineering departments. Heald, one of the foremost producers of precision grinding and boring equipment in this country, has taken a leaf from the experience of the automotive industry by mechanizing its final assembly department in a manner well worth special comment. They have a new assembly division in which all machines are built up on a mechanized conveyor line, served by sub-assembly stations located directly at points of usage. Besides speeding up the assembly process, this advanced technique aids materially in reducing the cost of fabrication, expedites the scheduling of a varied line of machinery.

On Forgings

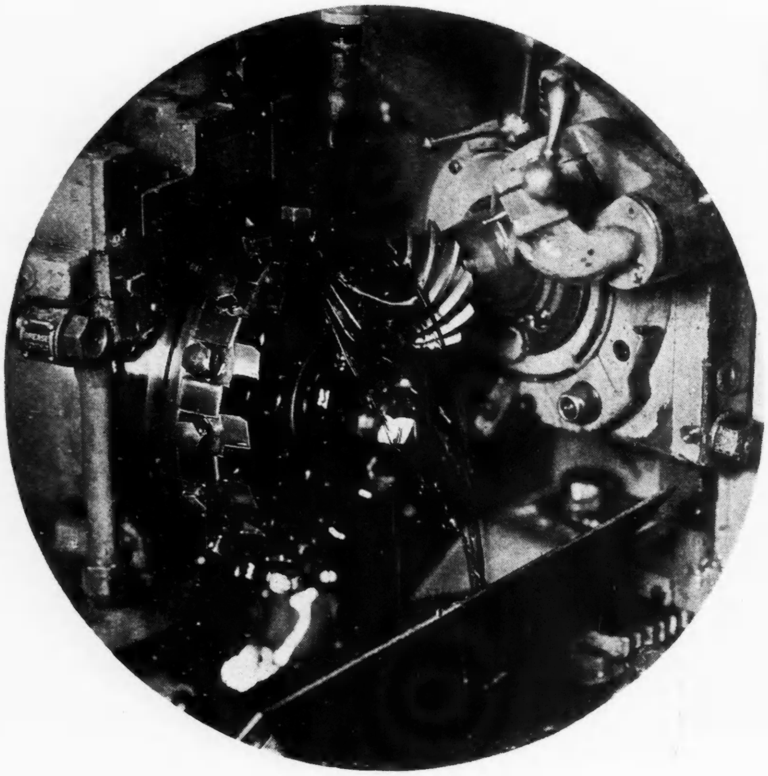
Important paper entitled, "Special Problems in the Production of Aircraft Engines," by Val Cronstedt, Pratt & Whitney Aircraft, which was presented at the recent SAE National Production Meeting, commented on the role of forgings in aircraft fabrication. According to Mr. Cronstedt, steel forgings are finding wide acceptance for several basic reasons. From the viewpoint of manufacturing economy they reduce machining time, initial cost, and raw material weight. From the engineering side of the picture, forgings are desired because they greatly improve the strength and endurance properties and, consequently, promote the development of trouble-free but extremely light structures.

By Induction

Some time ago in a special survey of flywheel machining practice we noted the widespread adoption of induction heating for expediting the shrinking-on of flywheel rings. Induction heating offers many advantages in cost economy, reduction of heating cycles, and most of all in the ability to apply heat without destroying the physical properties of the material employed. For these reasons the process should enjoy wider acceptance as time goes on. A logical application would be in the heating of aircraft cylinder heads to expedite the assembly of inserts by reducing the duration of the heating cycle.

Fluid Lift

An hydraulic mechanism for operating car windows by remote control has been perfected by one the energetic parts makers, already has been tested by several leading car producers. We understand, confidentially, that the device will be installed soon in a large fleet operation. Each window is independently operated, the raising and lowering of each window being effected by push buttons on the instrument panel.—J. G.



A high-speed photolight "froze" this excellent action view of a gear cutter in the Pontiac plant as it generated a bevel-drive pinion gear. Time: one 30,000th of a second. Note how the oil appears as a solid sheet to the camera lens

A 23,000-sq. ft. addition just completed for the Waterbury Tool Co. plant at Waterbury, Conn., substantially increases this company's capacity for the manufacture of pumps and hydraulic speed gears. The new plant will be known in the future as the Waterbury Tool Division of Vickers, Inc., for which the Austin Co. now is building a $500,000 addition comprising 110,000 sq. ft. in Detroit.

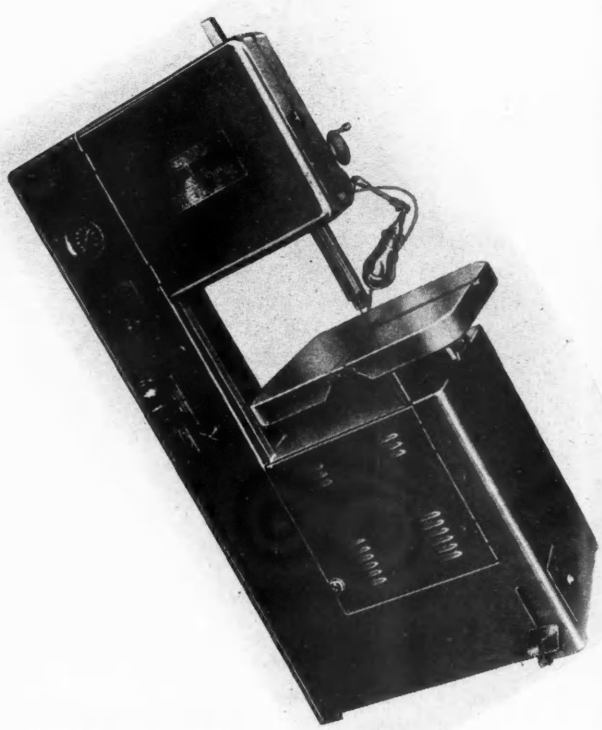
The George Gorton Machine Co., Racine, Wis., manufacturers of milling, die and mold duplicating and engraving machines, has announced the completion of a 12,000-sq. ft. factory addition. The

MEN and

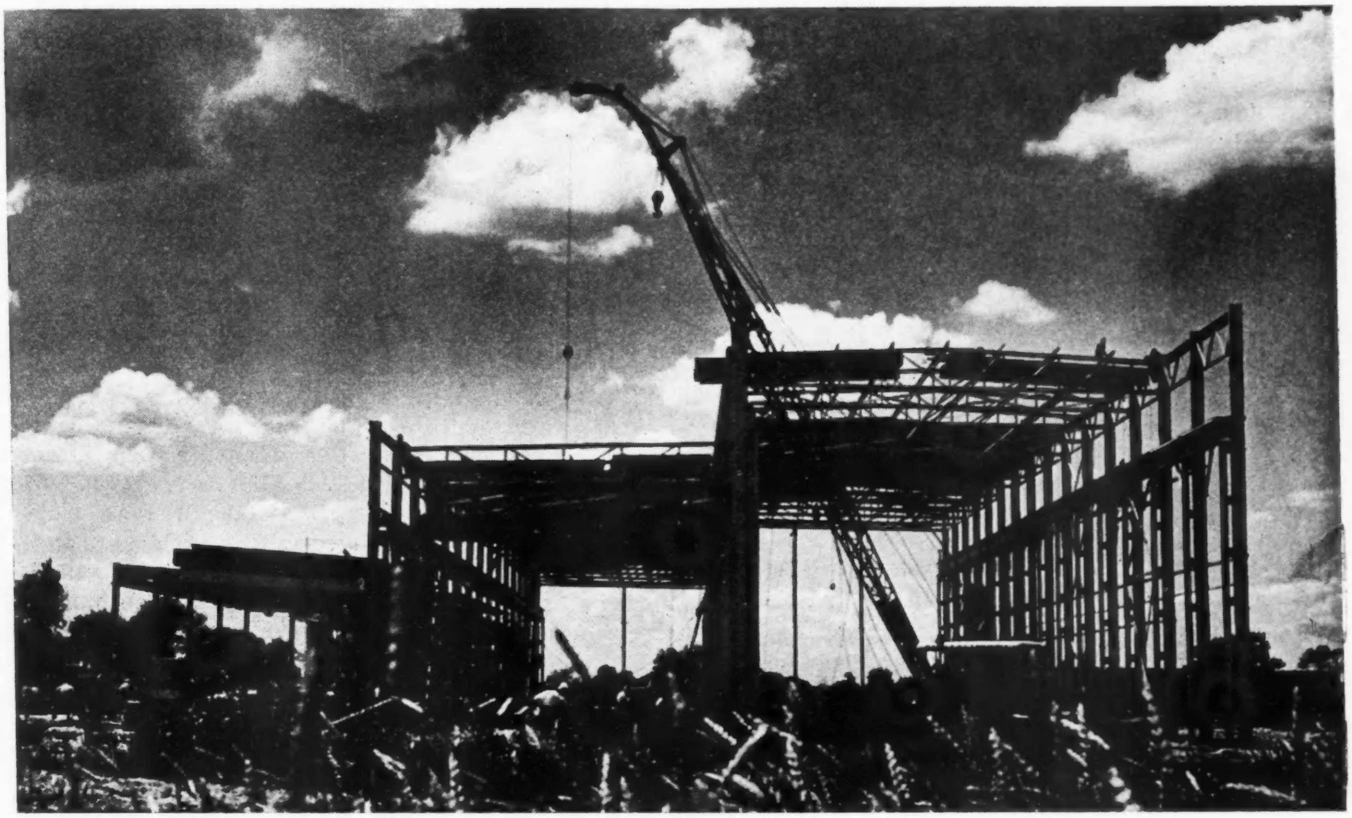
AS THE demand for machine tools in a war-racked world continues to increase, more and more American builders of this equipment are expanding and modernizing their manufacturing facilities. Within recent weeks announcements of factory additions completed or of new building contracts awarded have been made by the Hydraulic Press Mfg. Co., the Cleveland Punch & Shear Works Co., the George Gorton Machine Co. and the Waterbury Tool Co.

The Hydraulic Press Mfg. Co.'s new $500,000 plant at Mount Gilead, Ohio, is scheduled for completion this month. The more than 60,000 sq. ft. of floor space provided in the layout will be devoted exclusively to the manufacture of H.P.M. "Fastraverse" hydraulic presses. Contracts also have been awarded to the Austin Co. for a single-story office building adjacent to the factory now being erected. When the new buildings are completed, the company will have more than 100,000 sq. ft. of floor space at Mount Gilead for the manufacture of hydraulic power and control equipment and plastic molding machines.

Equipment is now in place in the new 34,000 sq. ft. addition to the Cleveland Punch & Shear Works plant at Cleveland. This all-welded structure adds 25 per cent of floor space to the company's Cleveland factory and increases production capacity 50 per cent. Among the new machines installed are an Ingersoll 96 in. by 144 in. by 24 ft. 8 in. bar, open side milling and boring machine; another Ingersoll mill 96 in. wide; a 72-in. Gray planer; a 96-in. Niles-Bement-Pond planer; two Bridgeford lathes with 36-in. and 52-in. swing and a Gamble, Stannard & Houston 54-in. lathe.

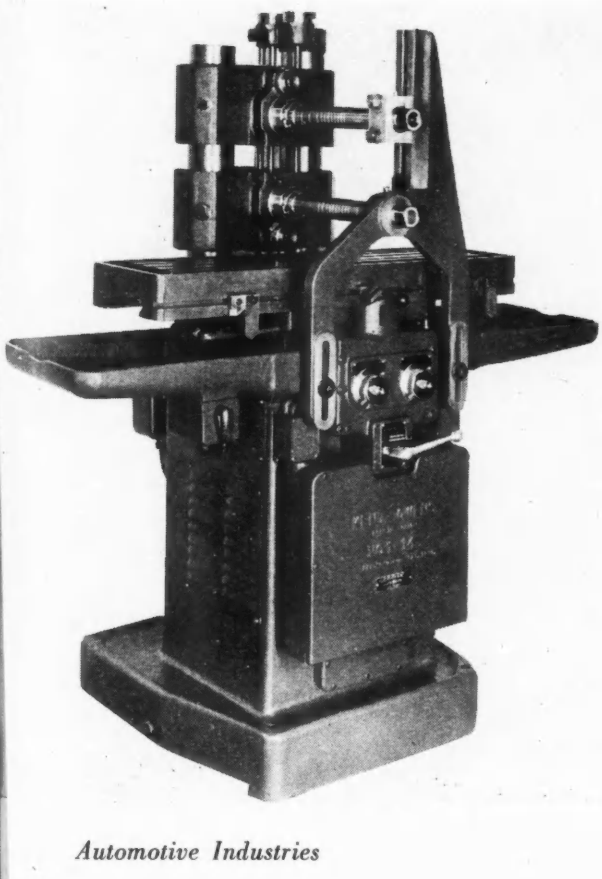


Grob Brothers 18-in. throat metal band saw



MACHINES

Symbolic of the expansion of manufacturing facilities now being undertaken by many American builders of machine tools is this view of the Hydraulic Press Mfg. Co.'s new $500,000 plant being constructed at Mount Gilead, Ohio



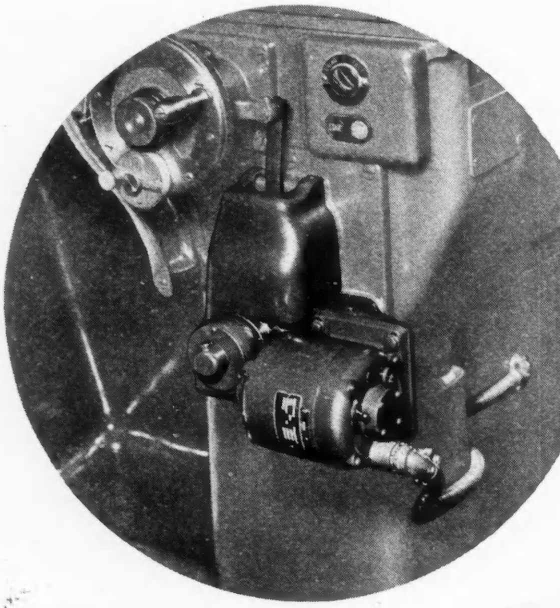
Double spindle arrangement applied to a Kent-Owens No. 1-14 hydraulic milling machine

building, designed by Albert Kahn, Inc., houses the assembly and shipping departments and a new stock room. Although the new structure was built primarily to relieve congestion in the assembly department, the company's machine output is expected to rise about 25 per cent.

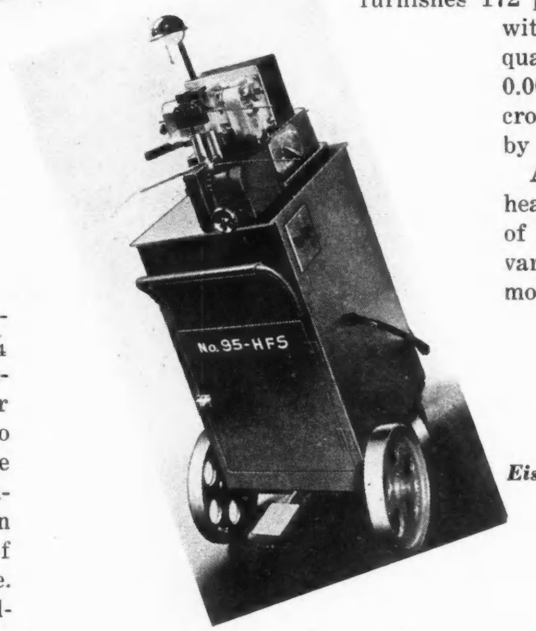
AMONG the new and improved machine tools is a new line of milling machines equipped with double spindles and manufactured by the Kent-Owens Machine Co., Toledo, Ohio. These machines are suited especially for splitting bushings, milling slots in pistons and other similar operations. They can be used on a wide variety of other parts where there are two or more surfaces spaced from each other and which can be milled to advantage by using two cutters mounted on different spindles.

The accompanying illustration shows double spindles mounted on a Kent-Owens No. 1-14 hydraulic milling machine. This machine has 14-in. table travel and a 32-in. by 9-in. table. Two panel dials control the feed rate of the table from ½ in. to 80 in. per minute.

Spindles are adjustable vertically and independently of each other by means of screws having micrometer



Brown & Sharpe independent automatic cross feed arrangement



dials. The center distance between the two spindles is 4¾ in. minimum and 11 in. maximum. The center of the lower spindle can be brought to within one inch of the table surface minimum and the center of the upper spindle can be raised to a maximum of 12 in. from the table surface. Each of the spindles is adjustable horizontally and independently of the other. This adjustment is 1½ in. and can be positioned accurately by means of micrometer dials. Spindle heads are supported on two ground cylindrical steel posts. The drive is from a standard foot mounted ball bearing motor mounted at the rear.

GROB BROTHERS, Grafton, Wis., has developed and is now building what is called the model NS-18 band saw. The machine is built for the tool room as well as for the general machine shop. Its cast-iron table of box section construction and heavily ribbed measures 24 in. by 24 in. and can be tilted four ways. In addition to being clamped in the conventional manner, the table is locked with a stabilizer which provides great rigidity. A Grob butt welder with built-in tool grinder is mounted in the frame and is used to join saw blades for internal cutting.

Both the upper and lower saw guides are adjustable in height. The lower saw guide can be brought flush with the table surface or above the table surface for special jobs. Guide holders are locked in proper position by an improved single lever quick acting clamp.

Ten speeds are provided from 50 to over 2000 ft. per min. to the saw blade, and a chart for the selection of saw blades as to width, number of teeth and speeds is mounted on the machine. This equipment will handle small, intricate jobs with blades as small as 1/16 in. by 0.025 in. and also, with the large throat of 18 in., it will cut extra heavy jobs using saw blades up to one inch wide. Optional features include: automatic hydraulic checked table feed, light attachment, air blower, circular cutting attachment, magnifying glass and tachometer.

BROWN & SHARPE MFG. CO., Providence, R. I., recently added an independent automatic cross feed arrangement to its line of auxiliary equipment available for use on B&S No. 5 plain grinding machines. The arrangement gives to the machine all the advantages of power plunge-cutting with no change in regular capacities or operating convenience. It furnishes 172 plunge-cut feeds or picks per minute, with the amount of feed adjustable by quarter-thousandths from 0.00025 in. to 0.0045 in. per pick. As with the regular cross feed, the stopping point can be set by increments of 0.0001 in.

A separately-controlled 1/20 hp. gearhead motor mounted at the right front of the machine drives continuously a variable-radius crank mechanism which is mounted below the similar unit regularly

(*Turn to page* 141, *please*)

Eisler portable butt welder with burr grinder.

New Westinghouse portable AC welder

Design of High Speed, Two-Stroke Engines

Section Three

Here the author traces exhaust factors that influence the design. Sections One and Two appeared in the July 1 and 15 issues respectively

By SCIPIONE TREVES, D.Sc., Mech. Engr.

AFTER HAVING traced the course of the exhaust process in some detail and pointed out the influences on it of various design and operation factors, it is now opportune to introduce the fundamental notion of port capacity, in order that we may have a characteristic parameter for the ports of a two-stroke engine operating at a given speed. Using the same symbols as in the previous sections, we will represent the *total port capacity* by the expression

$$E = \int_{-\Theta}^{+\Theta} F\, d\theta = b \int_{-\Theta}^{+\Theta} h\, d\theta \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

where the linear dimensions are measured in inches and angles in degrees. And we shall represent what may be called merely port capacity by the analogous expression

$$e = \int_{-\Theta}^{\theta} F\, d\theta = b \int_{-\Theta}^{\theta} h\, d\theta$$

This is evidently a function of the angle θ, which varies between the limits $-\Theta$ and $+\Theta$.

Suppose we plot on a diagram of Cartesian coordinates, angles θ of crankshaft rotation as abscissas, and heights h of port opening as ordinates; then the area enclosed between the curve thus obtained and the axis of abscissas exidently will represent the total port capacity on a convenient scale. The final ordinate of the whole diagram also may be considered to represent this capacity, since the ordinates of the diagram represent the variation of $e(\theta)$. It is at once evident that the average port-opening area F_m is given by the ratio between the total port capacity and twice the exhaust angle. That is to say

$$F_m = \frac{1}{2\,\Theta} \int_{-\Theta}^{+\Theta} F\, d\theta = \frac{E}{2\,\Theta}$$

It is now proposed to make some simplifying assumptions, with the object of arriving at a practical expression for the port capacity necessary in order that during the pressure-equalization phase of the exhaust period in an engine of known dimensions, the pressure may drop from its initial value p' to a given lower value p, which in a particular case may be assumed to be equal to the delivery pressure of the supercharging blower. Let us suppose, then, that a general layout of the engine has been made, and that the heights of the inlet and exhaust ports have been tentatively fixed.

Taking account of any possible phase difference between the crankshaft controlling the exhaust ports and that controlling the inlet ports, let θ' represent the angular distance of the exhaust-control crankshaft from the outer dead center at the moment the inlet ports begin to open. By comparing the expression just referred to, for the port capacity as a function of the pressures p' and p, with the expression for the same variable as a function of the characteristic dimensions of the engine in question as shown by the drawings, we have a handy means of rapidly checking the suitability of the dimensions chosen for the ports. The result will indicate whether a change in these dimensions is advisable.

From the equation

$$\theta = 360\,\frac{N}{60}\,t = 6\,N\,t$$

we get

$$d\theta = 6\,N\,dt,$$

and by combining with equation (1),

*Formerly professor in the Royal College of Engineering, Turin, Italy.

ENGINE DESIGN

$$e = 6\,N \int_{t'}^{t} F\,dt$$

$$= -\,6\,N \int_{G'}^{G} \frac{dG}{\mu\, w_k\, \gamma_k} \quad \ldots\ldots (11')$$

Now, during the pressure-equalization period, as implicitly inferred in the preceding calculations, not only does the area of the outflow passage vary, but also the volume of the vessel from which the flow takes place, owing to the movement of the pistons. But practical investigations indicate that the final result is little influenced by variations in cylinder volume during this period, and we will neglect these variations, for the sake of simplicity. We will consider the volume V' to be constant and will take account only of variations in the port-opening areas. We then have

$$G\,v = V = V' = G'\,v',$$

so that

$$dG = -\,G'\,v'\,\frac{dv'}{v^2} = -\,V'\,\frac{dv}{v^2} \quad \ldots\ldots (13)$$

which, as a result of the simplifying assumption made, takes the place of the more complicated equation (8').

We will assume, moreover, that, the same as before, the exponent of polytropic expansion in the cylinder and of outflow through the port ranges between the limits $n = 1.30$ and $n = 1.35$. We then have

$$\gamma_k = \gamma\left(\frac{p_k}{p}\right)^{\frac{1}{n}} = \frac{1}{v}\left(\frac{2}{n+1}\right)^{\frac{1}{n-1}} \quad \ldots (14)$$

$$\frac{p}{p'} = \left(\frac{v'}{v}\right)^{n} \quad \ldots\ldots\ldots\ldots (14')$$

Substituting in (11') the values obtained in (3), (13) and (14) we get

$$e = 6\,N \int_{G'}^{G} \frac{1}{\mu\sqrt{2g\,\dfrac{n}{n+1}\,p\,v\,\dfrac{1}{v}\left(\dfrac{2}{n+1}\right)^{\frac{1}{n-1}}}}\,V\frac{dv}{v^{2'}}$$

and by deducing from (14') that

$$\sqrt{p\,v\,\frac{1}{v}} = \sqrt{\frac{p}{v}} = \sqrt{\frac{p'}{v'}\,\frac{p}{p'}\,\frac{v'}{v}}$$

$$= \sqrt{\frac{p'}{v'}\left(\frac{v'}{v}\right)^{\frac{n+1}{2}}}$$

$$= \sqrt{R\,T'}\,\frac{v'^{\frac{n-1}{2}}}{v^{\frac{n+1}{2}}}$$

we finally get

$$e = 6\,N\,\frac{V'}{\mu\sqrt{2\,g\,\dfrac{n}{n+1}\,R\,T'}}\;\frac{1}{\left(\dfrac{2}{n+1}\right)^{\frac{1}{n-1}}v'^{\frac{n-1}{2}}}\int_{v'}^{v} v^{\frac{n-3}{2}}\,dv$$

$$= \frac{12\,N}{n-1}\,\frac{V'}{\mu\sqrt{2\,g\,\dfrac{n}{n+1}\,R\,T'}\left(\dfrac{2}{n+1}\right)^{\frac{1}{n-1}}}\left[\left(\frac{v}{v'}\right)^{\frac{n-1}{2}} - 1\right];$$

and hence,

$$e = K\,N\left[\left(\frac{p'}{p}\right)^{\frac{n-1}{2n}} - 1\right] \quad \ldots\ldots (15)$$

where

$$K = \frac{12}{\sqrt{2\,g\,R}}\,\frac{V'}{\sqrt{T'}}\,\frac{1}{\mu}\,\frac{\left(\dfrac{n+1}{2}\right)^{\frac{1}{n-1}}}{(n-1)\sqrt{\dfrac{n}{n+1}}} \quad . (16)$$

is a constant depending on features of design and operation of the engine. Remembering that, as in the foregoing,

$$g = 32.2 \text{ ft. per sec.}^2,\; R = 53.3, \text{ and } n = 1.35$$

$$e = K\,N\left[\left(\frac{p'}{p}\right)^{0.1296} - 1\right], \text{ sq. ft-degs.} \quad \ldots\ldots (15')$$

where

$$K = 1.21\,\frac{1}{\mu}\,\frac{V'}{\sqrt{T'}} \quad \ldots\ldots\ldots (16')$$

Equation (15) enables the designer not only to calculate the port capacity required to obtain a momentary pressure $p < p'$, but by reversing the procedure he can trace a diagram of the working pressures as a function of the crank angle (and, therefore, as a function of piston motion). A number of successively decreasing values of p are assumed, and by means of equation (15) the corresponding values of e are calculated. From these values for any given engine we then obtain the corresponding crank angles, either by reading them off on the axis of abscissas of a port-capacity diagram, if such a diagram has been prepared, or by obtaining them analytically.

For this purpose we can substitute for h in equation (10) its equivalent as given in equation (4), where the values of cos ψ and cos Φ as functions of θ and Θ respectively, are given by the well-known equation relating the angle of connecting-rod inclination to the crank angle. But the problem may be solved also in a simpler manner. If h_o is the maximum height of port opening (corresponding to the maximum port-opening area F_o), we evidently have

$$h_o - h = x,$$

where

$$x = 2\,r\left(\frac{1-\cos\theta}{2} - \frac{1}{8\,\lambda}\,\frac{1-\cos 2\,\theta}{2}\right)$$

is the distance of the piston from the bottom end of the stroke.[1] Here λ is the ratio of connecting rod length to stroke, and angles θ, in radians, must be measured, as before, from bottom dead center.

The port capacity then will be given by the equation

$$e = b\int_{-\Theta}^{\theta} h\,d\theta = b\int_{-\Theta}^{\theta}(h_o - x)\,d\theta$$

$$= b\int_{-\Theta}^{\theta}\left\{h_o - r\left[1 - \cos\theta - \frac{1}{8\,\lambda}(1-\cos 2\,\theta)\right]\right\}d\theta$$

$$= b\left[\left(h_o - r + \frac{r}{8\,\lambda}\right)\left(\Theta + \theta\right) + r\left(\sin\Theta + \sin\theta\right) - \frac{r}{16\,\lambda}\left(\sin 2\,\Theta + \sin 2\,\theta\right)\right].$$

[1] In writing this equation, powers of sin ϕ of orders greater than the third have been neglected. The resulting error is greatest when ϕ is close to 90 deg., but even in that case only the third significant figure of the value of the expression $x/(2\,r)$, as calculated from this equation, is uncertain.

If it is desired to insert the angles in degrees instead of in radians, in order to get the result in square inch-degrees as before,

$$e = b\left\{\left(h_o - r + \frac{r}{8\lambda}\right)\left(\Theta + \theta\right) + \frac{180}{\pi}\left[r\left(\sin\Theta + \sin\theta\right) - \frac{r}{16\lambda}\left(\sin 2\Theta + \sin 2\theta\right)\right]\right\} \quad (17)$$

In the same way we find for the total port capacity

$$E = b\left[2\left(h_o - r + \frac{r}{8\lambda}\right)\Theta + \frac{180}{\pi}\left(2r\sin\Theta - \frac{r}{8\lambda}\sin 2\Theta\right)\right] \quad (18)$$

and for the capacity at the moment of inlet-port opening,

$$e' = b\int_{-\Theta}^{-\theta'} h\,d\theta = b\left\{\left(h_o - r + \frac{r}{8\lambda}\right)\left(\Theta - \theta'\right) + \frac{180}{\pi}\left[r\left(\sin\Theta - \sin\theta'\right) - \frac{r}{16\lambda}\left(\sin 2\Theta - \sin 2\theta'\right)\right]\right\} \quad (19)$$

By a comparison of the two values of e', obtained by geometrical and thermodynamic reasoning respectively, as given by equations (19) and (15), in which a pressure p'' equal to that of the charge inside the cylinder is substituted for p, we obtain the fundamental equation for design calculations

$$b\left\{\left(h_o - r + \frac{r}{8\lambda}\right)\left(\Theta - \theta'\right) + \frac{180}{\pi}\left[r\left(\sin\Theta - \sin\theta'\right) - \frac{r}{16\lambda}\left(\sin 2\Theta - \sin 2\theta'\right)\right]\right\} = K\,N\left[\left(\frac{p'}{p''}\right)^{\frac{n-1}{2n}} - 1\right] \quad (20)$$

where K has the value given by equation (16) and where the first term may have to be diminished in the proportion of the cosine of the inclination of the outer portion of the piston head with respect to a plane normal to the piston axis, as was pointed out in the foregoing.

From the degree to which this equation is satisfied, the designer can judge the rationality of his layout. It will also enable him to determine what modifications must be made in order to improve the inlet and exhaust functions, on which the operation of the engine and its power depend.

In order to be able to properly judge the degree of precision and the modalities of application of equation (20), it will be well to briefly recapitulate the hypotheses which were made in its derivation and to discuss the type and magnitude of the errors introduced into the final result by these hypotheses.

The first assumption made was that during the pressure-equalization period the cylinder volume remains unchanged. As a matter of fact, during this period the volume increases by from 10 to 20 per cent, less, of course, in low-speed, and more in high-speed, such as racing engines. It follows that the cylinder-pressure line drops more rapidly than appears from the calculations; in other words, the port capacity given by equation (15) is a little larger than is really necessary, and the higher the speed of the engine the greater the difference.

Secondly, equations (3) and (14) are valid only for pressure ratios above the critical. Assuming that the pressure in the exhaust pipe is equal to one atmosphere[2] the cylinder pressure corresponding to the critical ratio is 1.85 absolute atmospheres. For cylinder pressures below 1.85 atmospheres absolute, equation (3) gives too high values for the velocity of flow, and, consequently, pressure drops which are higher than actually occur. We shall not discuss methods of compensation for this error inasmuch as errors due to the incorrect use of the outflow equation would be noticed only when the cylinder pressure has dropped below 1.4 atmospheres absolute, that is to say, when, the pressure-equalization period has been succeeded by the scavenging period, so that there is no need to proceed with the calculation.

It is, therefore, evident that while the above calculations give quite reliable results for engines of moderate speed, in the case of engines operating at very high speeds of revolution it is necessary, after a preliminary calculation has been made by the application of equation (15), to check the value arrived at for the pressure at the end of the pressure-equalization period by means of equation (7), as by a comparison of the two results we will arrive at a sounder basis for choosing the port capacity to be used.

* * *

Having traced the pressure diagram for the pressure-equalization period on the basis of the above calculation, and obtained the temperature of the burnt gases at the moment of inlet-port opening from the equation

$$T'' = T'\left(\frac{p''}{p'}\right)^{\frac{n-1}{n}},$$

we can calculate the weights of burnt gases in the cylinder at the beginning and end of this period by the following two equations:

$$G' = \frac{p'\,V'}{R\,T'} \quad \text{and} \quad G'' = \frac{p''\,V''}{R\,T''},$$

and the difference

$$G_c = G' - G''$$

will be the weight of gas which escaped from the cylinder during this period.

Therefore, if we designate by G_u and G_r the weights of burnt gas forced out of the cylinder during the scavenging and recharging period and that remaining in the cylinder at the beginning of the following compression period, respectively, we evidently have

$$G'' = G' - G_c = G_u - G_r \quad (21)$$

If G_f and G''' represent, respectively, the weights of fresh gas introduced (not including any which may pass directly out of the cylinder during the scavenging period) and the mixture of fresh and residual gases present in the cylinder at the beginning of the compression period, we have

$$G''' = G' = G_r + G_f \quad (22)$$

[2] This is true for engines which, like racing and aircraft engines, are operated without a muffler; for engines equipped with mufflers a back pressure of from 1.07 to 1.10 absolute atmospheres must be reckoned with.

Also, owing to the well-known laws of gaseous mixtures,

$$G_r T'' + G_f T_f = (G_r + G_f)\, T''' , \quad . \ . \ . \ . \ . \qquad (23)$$

where T_f is the absolute temperature of the fresh charge G_f immediately ahead of the inlet port, which may be readily measured in an engine already built, while for an engine under design it may be calculated from the temperature of the gases at the inlet to the supercharger blower. From equations (22) and (23) we find

$$G_f = G''' \frac{T'' - T'''}{T'' - T_f} = \frac{p'\,V'}{R\,T'} \; \frac{T'' - T'''}{T'' - T_f} \quad . \ . \qquad (24)$$

If we may consider the value of T'''[3] to be known from indicator diagrams taken from engines of similar type,[4] it is easy to find the value of G_f from equation (24) and then, by means of equations (21) and (22) we can find the values of G_r and G_u. The ratios

$$\xi_e = \frac{G_e}{G'}, \quad \xi_u = \frac{G_u}{G'}, \quad \xi_r = \frac{G_r}{G'} \quad . \ . \ . \ . \qquad 25)$$

which are thus found may be considered the characteristic coefficients for the given angular speed of the engine under consideration. These coefficients represent, respectively, the proportions of the total mass of gas in the cylinder at the moment of exhaust-port opening which, (1) escapes during the pressure-equalization period; (2) is forced out during the scavenging period, and (3) remains in the cylinder as residual gas.

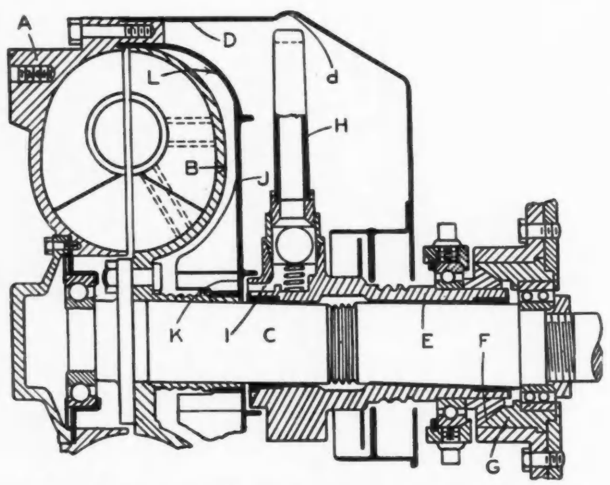
[3] See R. Devillers, Les Moteurs a Explosions, Dunod, Paris, 1920, Tome I, p. 61.

[4] See S. R. Treves, A Study of a Stock Engine with an Indicator, Automotive Industries, Vol. 55, No. 13 (Sept. 23, 1926).

New Hydraulic Coupling Obviates Need for Friction Clutch

At the present time, when a fluid flywheel or fluid coupling is used in connection with a transmission in which the different gear ratios are engaged by means of positive clutches, a separate friction clutch is needed to make gear changes possible while the car is in motion, as the fluid coupling has too much drag and too much inertia to permit smooth shifts. A hydraulic coupling which can be used without a friction clutch on automobiles having transmissions of the synchronizing-clutch type and a free-wheeling unit has been patented in England by H. Sinclair and A. C. Basebe, the arrangement being shown in the accompanying drawing. With this equipment it is necessary to disconnect the drive only when the car is stationary with the engine running.

The hydraulic coupling is of the usual Vulcan-Sinclair proportions and consists of an impeller A coupled to the engine crankshaft and a runner B whose shaft C is connected to the transmission. The reservoir casing has a cylindrical portion D and a circumferential bulge d. A sliding sleeve E is journaled on the shaft C and has a conical disc F that engages a complementary drum G fixed to the transmission housing when the sleeve is slid back. The part of the sleeve within the housing carries three scoop tubes H, two of which are of large bore and have their mouths near the cylindrical wall of the reservoir, while the third is of smaller bore and has its mouth in the circumferential bulge d.



Vulcan-Sinclair fluid coupling with means for emptying working chamber to reduce drag when idling.

The bores of the scoop tubes communicate with circumferential ports I in the front end of sleeve E. A spring-loaded valve disc J slides on the runner shaft C between the runner and the sleeve, and has ports K registering with ports I in the sleeve. The valve-disc diameter is roughly equal to the mean diameter of the bore of the working circuit, and it seats on the inner edge of an annular ring casing L which shrouds the back of the runner and is fixed to the impeller. During normal operation, sleeve E is in its rearmost position and is held stationary by cone brake F, G. Valve J is held closed by its spring, and the oil that leaks from the working chamber to the reservoir is picked up by the small-bore scoop tube and returned through ports K in the valve disc.

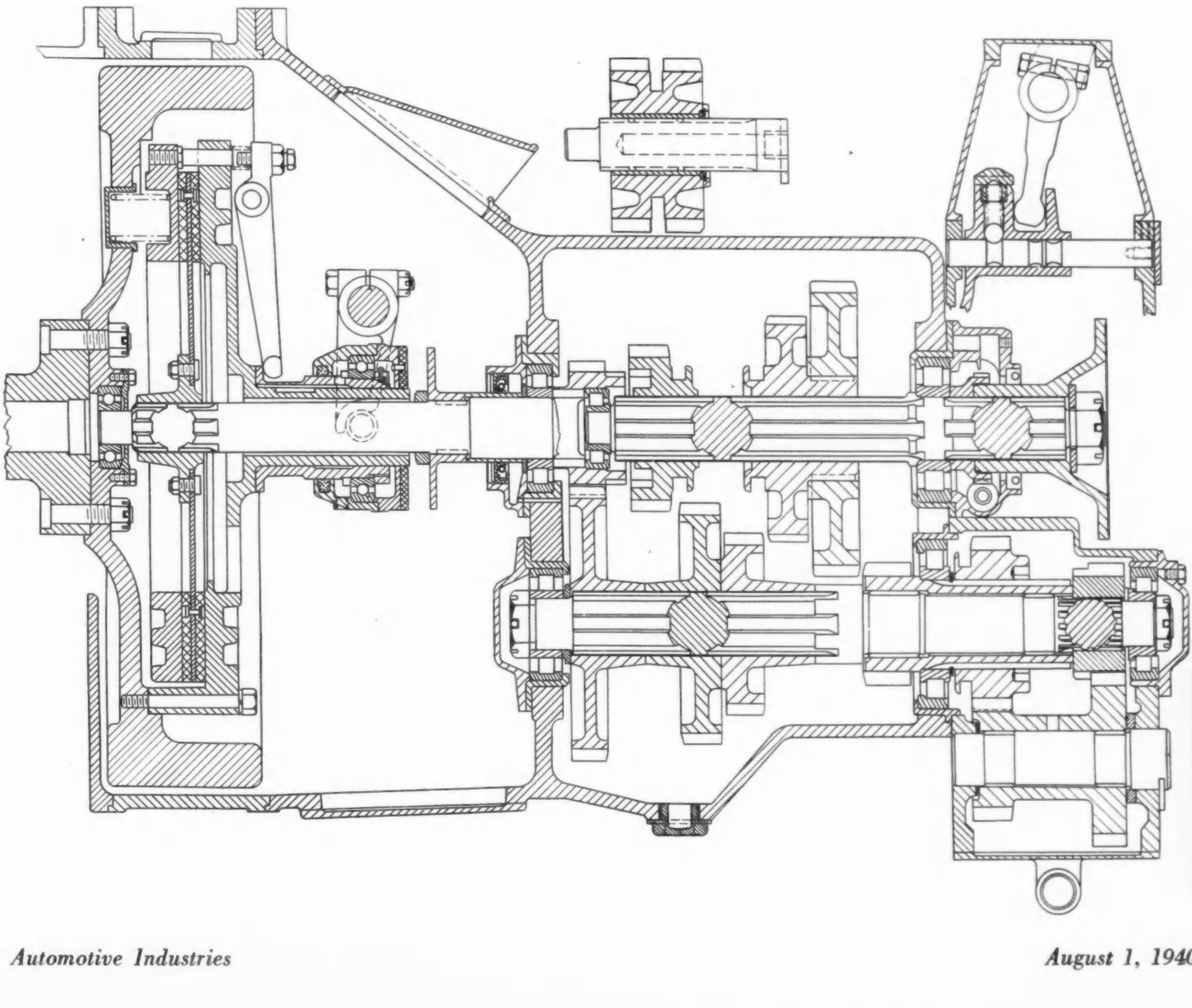
To reduce the drag torque while the runner is stalled, sleeve E is moved forward by depressing the control pedal. Brake F, G is disengaged, the front end of the sleeve unseats the valve disc, and oil is rapidly exhausted from the working chamber into the reservoir. After about 60 per cent of the total oil is exhausted, the emptying process ceases. The oil in the reservoir carries the scoop tubes around with it, since the sleeve is free to rotate. To refill the working chamber, the sleeve is returned to its rearmost position and valve J closes. All three scoop tubes then return oil to the working chamber.

FODEN FOUR-SPEED TRANSMISSION WITH SUPER-LOW (FIFTH) SPEED

The four-speed transmission of Foden Diesel-engined trucks is now being offered with a fifth ratio—a "super-low" forward and reverse gear—as an option at extra cost. Provision of the fifth speed entails no serious structural alteration of the standard four-speed transmission unit, though a longer layshaft is required. The casing of the super-low ratio displaces the standard end-cap of the four-speed layshaft. Engagement is effected by a separate gearshift lever mounted on a bracket immediately behind the existing lever for the usual four speeds.

As shown in the accompanying drawing, the extended layshaft has a combined pinion and dog attached to its rear end, while the low-speed pinion within the main casing is integral with a sleeve carried by the layshaft on needle roller bearings at each end. Sliding on the outer splined surface of this sleeve is another pinion; this has two positions, viz., (1) meshed, as in the drawing, with a double gear on a supplementary layshaft, in which position the super-low gear is operative if the standard gear lever is in either low speed or reverse; and (2) moved rearward with its dog teeth engaged with those of the end pinion on the extended main layshaft, which is the normal position enabling the standard four speeds to be used in the orthodox manner.

The transmission ratio provided by the super-low gear is 11.63 to 1, either forward or backward (approximately double the reduction of the normal low and reverse gears, 5.38 to 1); it implies a road speed of 2.86 m.p.h. at 1700 r.p.m. with a 6 to 1 rear axle drive and 36-in. wheels.

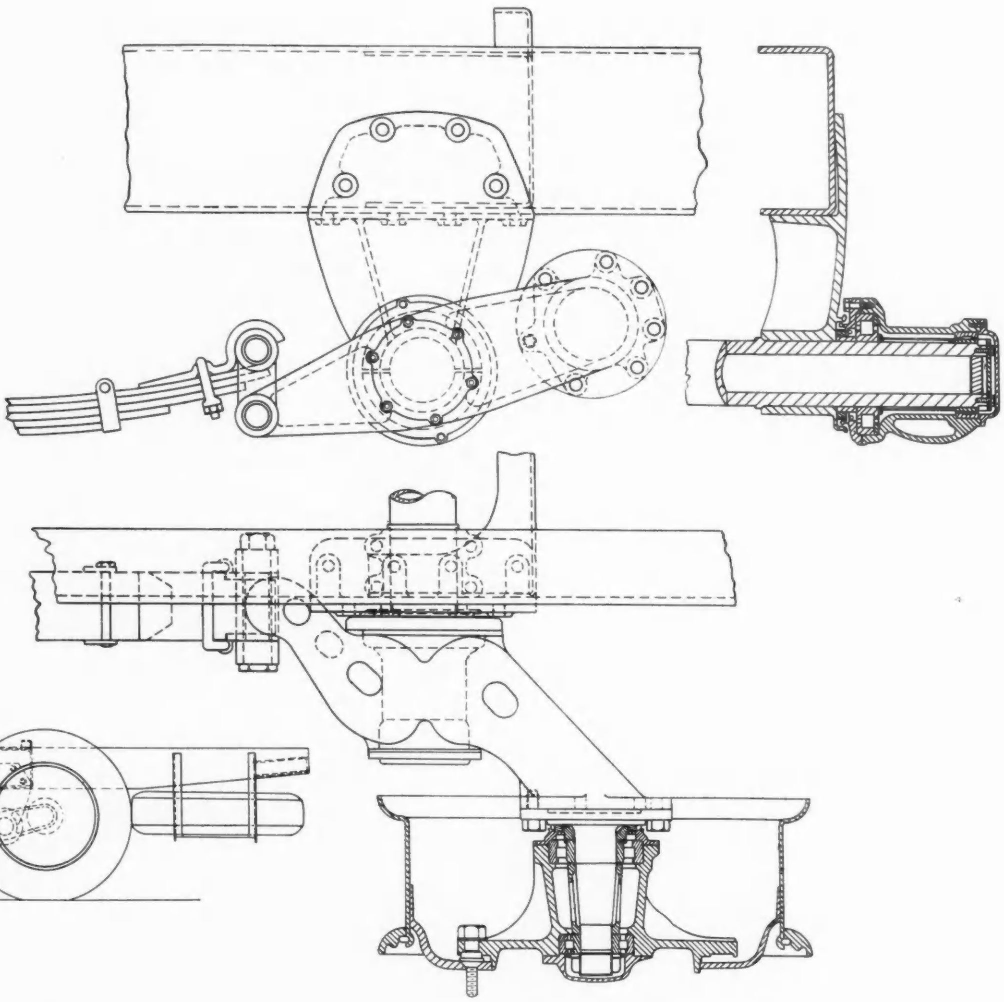


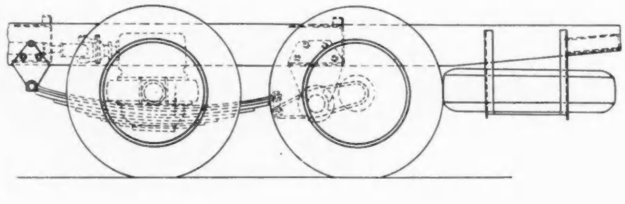
NEW FODEN TRUCK WITH TRAILING REAR WHEELS

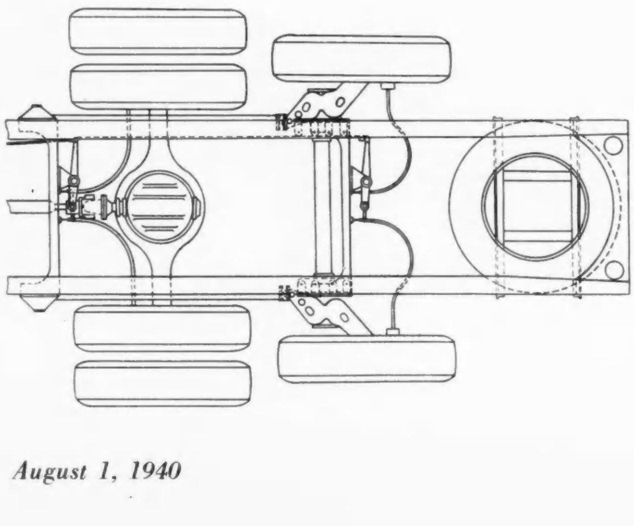
Fodens have introduced a new three-axle model for loads up to 25,000 lb. It is notable in having a rear bogie comprising two trailing wheels with single tires, for load-carrying only, behind its dual-tired driving wheels.

Half-elliptic springs, 54 in. long, underslung from the driving axle, are shackled at their rear ends to the front member of two offset fulcrum arms, mounted independently, one at each side of the chassis, at the ends of a cross tube. The rear member of each arm has a flanged stub axle bolted to it, this axle carrying a standard front hub and wheel on roller bearings. The fulcrum arms also are mounted on roller bearings on the inside and on needle bearings at the outer end.

The fulcrum arms have $9\frac{1}{8}$ in. centers. The cross tube on which they are carried is of $3\frac{1}{2}$ in. diameter and is supported by brackets descending from the channel steel side rails of the frame. The main leaf of each half-elliptic spring has integral eyes backed by a reinforcement plate that encircles the top half of the eye and is held in place by a U-bolt passing over the three upper leaves.







The trailing wheels have a 66-in. track, this being 8 in. less than the front wheel track and $\frac{3}{4}$ in. more than the mean track of the dual-tired driving wheels. Front suspension is by conventional half-elliptic springs.

A five-cylinder direct-injection Gardner oil engine of 425.5 cu. in. piston displacement is used for this new Foden truck; it develops 85 b.hp. at 1700 r.p.m. with its maximum torque of 284 lb.-ft. at 1100 r.p.m. The cylinders have hardened dry liners and are cast in blocks of two and three.

NEWS OF THE INDUSTRY

Aircraft Divisions Formed By Briggs Mfg. and Murray Corp.

Two of the Largest Suppliers of Automobile Bodies Shortly to Undertake Manufacture of Airplane Parts

Two of the largest suppliers of bodies in the automotive industry have entered the aircraft manufacturing field with announcement by the Briggs Mfg. Co. and the Murray Corp. of America that they have formed aircraft divisions at their Detroit plants. Briggs has signed a contract with the Vought-Sikorsky Division of the United Aircraft Corp. to manufacture metal wing assemblies for U. S. Navy all-metal monoplanes.

Briggs will utilize 75,000 sq. ft. of floor space at the vacant LeBaron plant on Detroit's east side for its aviation activities. Necessary equipment will be installed by Sept. 1, when manufacturing operations will begin. The first order is scheduled for delivery in November, but the terms of the contract with Vought-Sikorsky have not been revealed. Plans for further expansion of the aircraft facilities as additional orders warrant have been approved.

Ben Jacobson, former plant manager of the Barkley-Grow Aircraft Corp., Detroit, has been named general manager of Briggs' aircraft division. Among his associates will be Brig.-Gen. W. E. Gilmore, former assistant chief of the U. S. Army Air Corps. The operating personnel of the Barkley-Grow company, which recently was purchased by the Aviation Corp., has been taken over by Briggs. Approximately 700 men will be employed on the aircraft manufacturing operations.

Murray Corp. is preparing space in two of its plants for aircraft assembly operations. The company expects to be ready by Nov. 1 for the manufacture of all-metal wing and tail surfaces and other similar airplane parts which call for the use of stamping equipment.

An aircraft engineering division has been formed under the direction of Richard C. Gazley, who resigned June 30 as chief of the technical development section of the Civil Aeronautics Authority after 13 years' service. The aircraft parts program will be under the general supervision of L. Clayton Hill, vice-president in charge of manufacturing.

Three aircraft companies already are consulting with Murray Corp. relative to the manufacture of fuselage and wing sub-assemblies.

Report Indicates Growth of British Automotive Exports

Great Britain's automotive industry, operating in the face of production difficulties and the loss of important markets, is represented in a report to the Commerce Department as having been able to expand appreciably its export trade since the outbreak of war. The report said that the development is regarded with satisfaction by British officials, who hold the maintenance of export trade ranks in importance next to satisfying the national requirements.

While official export figures are not available, reliable unofficial statistics, the report declared, show that during the first seven months of the war British exports of motor vehicles reached 30,000 units, a total said to represent a 25 per cent increase over similar shipments during the corresponding period of 1938-1939. Empire countries, particularly Australia, India, Malaya and Ceylon, were reported as remaining the best export markets for British automotive products; but increased trade with Uruguay, Argentina and Portugal was noted by the report.

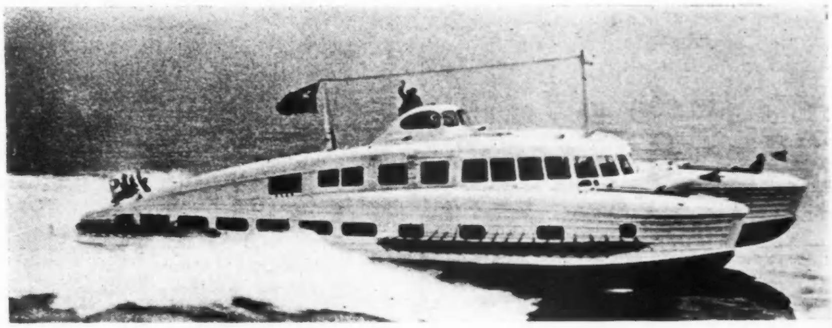
Auburn Applies For Curb Listing

Application for listing 375,000 shares of no par value common stock has been made by Auburn Central Mfg. Corp. to the New York Curb Exchange. The application was made in connection with a plan of reorganization of Auburn Automobile Co. Total authorized capital structure of the new corporation is 25,000 shares of four per cent convertible preferred stock of $50 par value a share, and 500,000 shares of no par value common stock.

The new corporation is successor to the Auburn Automobile Co. Products will be light delivery trucks, automobile bodies and sheet metal products, including refrigerator cabinets, bottle collars, kitchen cabinet equipment, pressed steel sinks and similar equipment.

Wilson Foundry Remodels Plant

Wilson Foundry & Machine Co., Pontiac, Mich., is spending $200,000 to remodel its plant so it will be prepared to undertake national defense contracts.



International

Russian Conception of a Ferryboat

Action view of a twin-hull express motorboat which the Soviet Government recently put into service between Sochi and Sukhumi on the Black Sea. It has accommodations for 140 passengers and is said to be capable of speeds up to 80 kilometers per hour

NEWS

Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE INDUSTRIES**

General business activity since the partial interruption due to observance of Independence Day has regained levels approximating those previously prevailing. The index of *The Journal of Commerce*, without seasonal adjustment, for the week ended July 13 stood provisionally at 102.1 per cent of the 1927-29 average, as against 103.6 a fortnight before. The adjusted index of The New York *Times* for the week ended July 6, fell to 100.4 per cent of the estimated normal from 103.2 in the preceding week, as compared with 86.7 a year ago.

Retail trade in the second week of July registered normal recovery from conditions peculiar to a holiday period. Department store sales during June advanced contrary to the usual seasonal tendency, the Federal Reserve adjusted index rising to 93 per cent of the 1923-25 average, as compared with 87 in May and 86 a year ago.

Production of electricity by the light and power industry during the week ended July 13 rose against the seasonal trend, but the excess above the comparable output last year fell to 6.8 per cent from 9.0 per cent in the preceding week.

The number of railway freight cars loaded in the same period, 749,465, was 16.3 per cent more than loadings in the week before and 10.5 per cent above the comparable 1939 figure.

Bank debits to other than interbank accounts in leading cities during the 13-week period ended July 10 were five per cent above the corresponding total last year.

Crude oil production during the week ended July 13 declined slightly to an average of 3,560,750 barrels daily, falling 67,650 barrels below the output required according to the computation of the Bureau of Mines, as against a similar margin of 26,000 barrels in the preceding week.

Engineering construction contracts awarded during the week ended July 18 rose to the unprecedented total of $217,834,000, including $177,736,000 for Government defense work, according to *Engineering News-Record*. For the year to date the aggregate is virtually equal to the comparable 1939 figure—a gain of 22 per cent in private work offsetting a drop of 10 per cent in public construction.

Cotton-mill activity advanced contra-seasonally in the first week of July. The New York *Times* adjusted index was 150.0, as compared with 144.2 for the week before and 120.0 a year ago.

Business failures during the week ended July 11 numbered 261, according to the Dun & Bradstreet compilation, as compared with 259 in the preceding week and 272 a year ago.

Professor Fisher's index of wholesale commodity prices for the same period rose further to 82.5 per cent of the 1926 average, as against 82.1 a fortnight earlier.

Excess reserves of the member banks of the Federal Reserve system rose $50,000,000 during the week ended July 17 to an estimated new peak of $6,880,000,000. Business loans of the reporting members increased $9,000,000 in the preceding week to a total of $4,447,000,000, exceeding by $560,000,000 the comparable amount last year.

Machine Tool Builders Discuss Defense Needs at Washington

While President Can Establish Priorities, Voluntary Arrangements Will Be Continued As Long As Possible

Members of the defense committee of the National Machine Tool Builders' Association, meeting in Washington for the first time since the Secretary of the Treasury relinquished his machine tool coordinating activities to National Defense Commissioner William S. Knudsen, were told on July 17 that, although the President was given authority in recent legislation to establish priorities for defense requirements, present plans call for a purely voluntary arrangement on the theory that it is preferable to continue on a cooperative basis as long as possible before invoking more drastic action.

While representatives of the War and Navy Departments and the National Defense Advisory Commission emphasized that under the voluntary plan it will be impossible to suggest a definite percentage of machine tool defense allocations applicable to all manufacturers, members of the industry's defense committee were advised that "obviously substantial percentages of capacity will ultimately have to be reserved for defense needs."

The scheduled machine tool meeting was referred to in Mr. Knudsen's progress report made public by the White House on July 16, at which time it was announced that it would take up "a cooperative plan under which a definite percentage of machine tool manufacturing facilities will be reserved for defense needs." Conferees said after the meeting that nothing definite was determined along the lines of fixing specific proportions as between defense and other machine tool orders but that in general the suggested percentages will vary with different manufacturers, some of whom have an excess of capacity, and with different types of machines.

Representatives of the machine tool industry were assured by Mr. Knudsen that with a continuation of the industry's cooperative spirit there will be no necessity for resorting to drastic steps to establish priorities. Members of the industry who have evidenced a desire to learn more about the machine tool requirements of the enlarged defense program were promised by Col. H. K. Rutherford, chief of the Army's Planning Branch, that they will be furnished with advance information from which they will be able to make their plans accordingly.

Industry members were represented after the conference as feeling that with such assurances they will now lose no time in adjusting their facilities in the interest of national defense.

Other conferees included H. B. Vance, board chairman of the Studebaker Corp., who is Mr. Knudsen's consultant on machine tools; Donald M. Nelson, coordinator of defense purchases; Brig. Gen. Charles T. Harris, assistant chief of Army Ordnance; Capt. Edmund D. Almy, of the Navy's shore establishment division; and the 15 members of the machine tool builders' defense committee headed by Clayton R. Burt, president of Pratt & Whitnew, Hartford.

Mr. Vance, who has been in Washington almost continuously since being named to Mr. Knudsen's staff although he plans to serve on a part-time basis, reiterated to AUTOMOTIVE INDUSTRIES that the embargo authority, contained

Amphibian

This odd-looking "What-Is-It?" being contemplated by its creator, Paul Pankotan of Miami, Fla., is designed to operate as an automobile or as a boat. The conversion is accomplished by a mechanism that lifts the wheels into the position demonstrated by the model.

Acme

in the recent approved May-Sheppard bill, has contributed substantially to the retention in this country of vital machine tool units which otherwise would have been exported.

In accordance with the procedure adopted after enactment of the May-Sheppard bill, Lieut. Col. Russell L. Maxwell, administrator of export control under the new authority, has the job of determining, with the advice of the War and Navy Departments and members of the Defense Advisory Commission, which items in the list of products are to be embargoed.

Ourselves & Government

A Check List of Federal Action Corrected to July 26

FEDERAL TRADE COMMISSION

F.O.B. PRICE CASE — Testimony continues in Ford case. Commission awaiting GM's supplemental brief.

TRADE PRACTICE RULES—Announced that Commission is still working on automobile trade practice rules but does not know when they will be promulgated. Probably be a month or so yet. Trade's opposition to issuance of rules disregarded.

EXCLUSIVE DEALER CASE—Date not yet set for taking testimony in GM-AC case. Commission reply brief due Aug. 5 in GM Sales Corp. case.

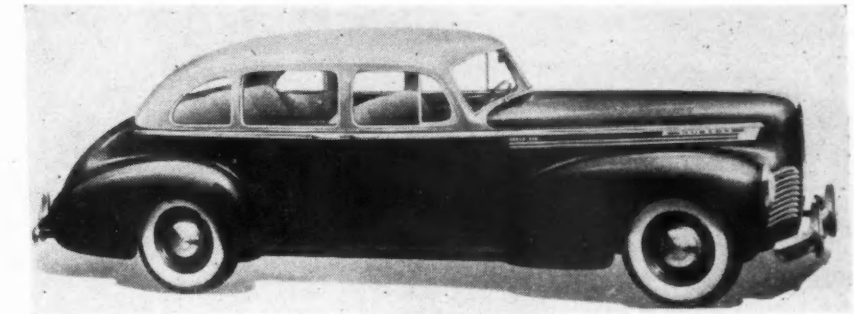
40 YEARS AGO

The comment is sometimes made that the bells commonly used on automobiles are not distinctive enough in sound to serve as a warning when used in the midst of trolley cars on the one hand and bicycles on the other. If one particular kind of bell were used on motor carriages, and if this were sufficiently unlike the bells used on either of the other conveyances mentioned, everyone would soon learn to recognize and heed the warning.

Probably the most distinctive thing now in use is the horn adopted in France. Possibly the reason why it is not more commonly adopted in this country is that, as at present arranged, it must be worked by the hand, whereas American builders prefer to assign minor operations to the feet, leaving the hands as free as the prime work of steering and speed controlling will permit.—From *The Horseless Age*, August 1900.

Readers Please Note

It has been found necessary to discontinue, at least temporarily, the AUTOMOTIVE INDUSTRIES' "Summary of Automotive Production Activity."



First of the 1941 Crop

One of the three new 1941 Hudson cars. Longer wheelbases and new body treatment, the latter called Symphonic Styling, are features of the entire line.

Truck Production by Capacities

(U. S. and Canada)

	SIX MONTHS			Per Cent of Total	
	1940	1939	Per Cent Change	1940	1939
1½ Tons and less	392,268	371,476	+ 5.8	89.21	92.03
2 to 3 Tons	26,973	18,097	+ 49.1	6.13	4.48
3½ Tons and over	7,787	6,597	+ 18.0	1.77	1.63
Special and buses	3,536	3,053	+ 16.0	.81	.76
Station Wagons	9,160	4,406	+108.0	2.08	1.10
Total	439,724	403,629	+ 19.0	100.00	100.00

Monthly Motor Vehicle Production

(U. S. and Canada)

	PASSENGER CARS		TRUCKS		TOTAL MOTOR VEHICLES	
	1940	1939	1940	1939	1940	1939
January	375,476	292,869	74,016	64,093	449,492	356,962
February	350,535	253,914	71,690	63,606	422,225	317,520
March	364,947	312,392	75,285	77,107	440,232	389,499
April	375,626	286,200	76,807	68,066	452,433	354,266
May	338,353	249,455	74,139	63,793	412,492	313,248
June	294,779	257,289	67,787	66,964	362,566	324,253
6 Months	2,099,716	1,652,119	439,724	403,629	2,539,440	2,055,748
July	......	155,850	......	62,750	......	218,600
August	......	62,475	......	40,868	......	103,343
September	......	165,119	......	27,560	......	192,679
October	......	259,610	......	65,079	......	324,689
November	......	295,134	......	73,407	......	368,541
December	......	384,858	......	84,260	......	469,118
Total	......	2,975,165	......	757,553	......	3,732,718

Passenger Car and Truck Production

(U. S. and Canada)

				SIX MONTHS		
	June 1940	May 1940	June 1939	1940	1939	Per Cent Change
Passenger Cars—U. S. and Canada						
Domestic Market—U. S.	276,949	315,441	233,311	1,959,148	1,478,551	......
Foreign Market—U. S.	9,091	10,235	13,393	68,282	103,600	......
Canada	8,739	12,677	10,585	72,286	69,968	......
Total	294,779	338,353	257,289	2,099,716	1,652,119	......
Truck—U. S. and Canada						
Domestic Market—U. S.	49,505	56,340	49,043	334,953	298,375	......
Foreign Market—U. S.	9,091	9,199	13,991	66,145	81,463	......
Canada	9,191	8,600	3,930	38,626	23,791	......
Total	67,787	74,139	66,964	439,724	403,629	......
Total—Domestic Market—U. S.	326,454	371,781	282,354	2,294,101	1,776,926	......
Total—Foreign Market—U.S.	18,182	19,434	27,384	134,427	185,063	......
Total—Canada	17,930	21,277	14,515	110,912	93,759	......
Total—Cars and Trucks—U. S. and Canada	362,566	412,492	324,253	2,539,440	2,055,748	......

Acme

Reunion

One of America's unique organizations is the Horseless Carriage Club of Los Angeles, composed of more than 250 members from all parts of the country whose hobby is the collection and preservation of old-time automobiles. Posed in a 1910 Fiat, at the club's annual field day held recently, are (left to right) Louis Mikrent, Barney Oldfield and Earl Cooper, three famous race drivers of yesteryear.

Plenty of Plastics

This country's facilities for the production of plastics are ample to meet any demands for the mass production of airplanes in the opinion of Harry M. Dent, president, Durez Plastics & Chemicals, Inc.

"Whether plastics continue to be used for parts alone or in the event that entire fuselages are made from plastic materials," says Mr. Dent, "the industry will have no trouble in supplying materials. There will be no bottleneck in the plastics industry."

Ingot Output Attains A New High For 1940

Demand Mostly for Heavy Products and Steel Producers Eagerly Await Start of Tonnage Buying By Car Builders

Automobile manufacturers continue to view the steel market from the sidelines, most of them having a sufficiently large nest-egg of material for their initial 1941 model assemblies. Quite a little in the way of sheet and strip steel, bought during the lower price period of last spring, remains on the unfilled tonnage books of finishing mills, awaiting specifications and shipping releases. In spite of the demand for steel from other industries, most of which is for heavy products, such as structural material, producers are looking forward eagerly to the resumption of tonnage buying by automotive consumers.

Mill operations, measured in terms of ingot output, rose to a new high for the year during the week ended July 27, the American Iron & Steel Institute estimating 88.2 per cent of capacity as being in use. This compares with 86.8 per cent in the preceding week, but in the last quarter of 1939, when there was no rearmament program afoot, this rate was exceeded. For rolling and finishing units, equipped to produce body and fender stock, to attain operating rates comparable with those mills in which heavier products are made, representative purchases by automobile manufacturers are necessary, and, therefore, interest in the steel market centers on when this buying will get under way.

The character of the prevailing steel demand is such that many of the smaller producers feel that it benefits chiefly their large competitors, and this tends to sharpen the competitive spirit. In spite of the higher cost of operation, some obsolete equipment is being pressed into service to enable makers to compete on a wider front. More and more blast furnaces are being put into operation, and iron output is being speeded up.

Details of the contract between the Government, acting through the Reconstruction Finance Corp., and the Metals Reserve Co. for the purchase of 75,000 tons of tin at 50c. per lb., c.i.f. New York, have now become available. All of the tonnage is intended to be purchased before June 30, 1941. The tin, so acquired, may be released to private consumers "in the event of a national emergency." The agreement runs for three years from Jan. 1, 1941, after which the stock may be liquidated at a rate of not more than 5 per cent and not more than 5000 tons in any three-month period. Thus, it would take between three and four years to liquidate this reserve, if it were so desired.

For the time being the market appears to have settled on a basis of 51 and 51¼c. per lb. for spot Straits tin. A rumor that some tin was lost in the sinking of two British freighters by a German raider off the West Indies comes as a reminder that this price

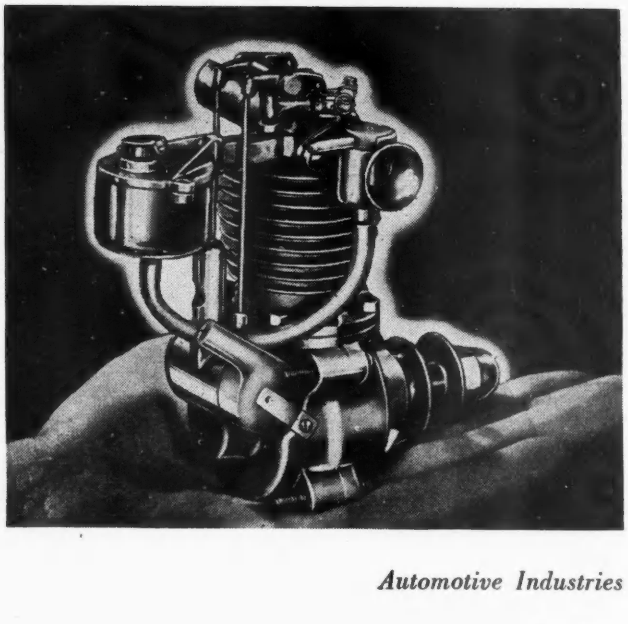
(*Turn to page* 130, *please*)

Machine and Tool Progress Exhibit

The week of March 24 to 29 has been selected for the 1941 Machine and Tool Progress Exhibition according to an announcement from the American Society of Tool Engineers. The exhibition will be held in conjunction with the A.S.T.E. annual convention in Detroit and will be held at Convention Hall, as were the 1938 and 1939 shows. Reservations for exhibit space will not be accepted prior to the mailing of formal application blanks in October, previous exhibitors being given first choice of space at that time.

2/3 Hp.

Model builders are being offered this new overhead valve engine that furnishes 2/3 hp. and weighs only 15 oz. Known as the Feeney four-cycle, this air-cooled engine is built in three models with 20 cc., 15 cc. and 10 cc. displacement. The 20 cc. unit has a bore of 1 3/16 in. and a stroke of 1 1/6 in.



New Car Registrations and Estimated Dollar Volume by Retail Price Classes*

	MAY, 1940		FIRST FIVE MONTHS, 1940 †			
	Units	Dollar Volume	Units	Per Cent of Total	Dollar Volume	Per Cent of Total
Chevrolet, Ford and Plymouth	187,105	$143,100,000	813,408	54.72	$621,800,000	48.39
Others under $1,000	108,754	98,300,000	474,914	31.95	429,800,000	33.44
$1,001 to $1,500	43,053	48,600,000	187,330	12.60	212,000,000	16.49
$1,501 to $2,000	1,478	2,600,000	6,729	.45	11,700,000	.91
$2,001 to $3,000	837	2,100,000	3,973	.28	9,700,000	.75
$3,001 and over	5	25,000	59	......	300,000	.02
Total	341,232	$294,725,000	1,486,413	100.00	$1,285,300,000	100.00
Miscellaneous	559	....	1,222	......	....	......
Total	341,791	....	1,487,635	......	....	......

* All calculations are based on delivered price at factory of the five-passenger, four-door sedan in conjunction with actual new registrations of each model. The total dollar volumes are then consolidated by price classes.
† Includes Oklahoma for first three months only.

Chrysler Corp. and UAW-CIO Appeal Compensation Decision

No Hearing Anticipated Until October When the Michigan Supreme Court Will Reconvene

Both the Chrysler Corp. and the UAW-CIO have filed appeals with the Michigan Supreme Court to the decision of Judge Leland W. Carr, who affirmed the award of upwards of $1,500,000 in unemployment compensation to 23,000 Chrysler employes on June 12 in Ingham County Circuit Court at Lansing. The benefits accrued from last fall's 54-day strike at the Chrysler Corp.

Chrysler Corp. attorneys maintained that the company's Detroit manufacturing operations constitute one establishment and, therefore, all the employes had a direct interest in the dispute which centered in the Dodge main plant. Maurice Sugar, attorney for the UAW-CIO, appealed on behalf of 12,000 workers in the Dodge main, forge and truck plants, who were ruled ineligible for benefits by Judge Carr after being declared entitled to benefits by the Appeal Board of the Michigan Unemployment Compensation Commission.

The appeal probably will not be heard before the Michigan Supreme Court reconvenes in October after the summer recess.

Meanwhile, Judge Carr was given until Aug. 8 to answer a show cause order of the Michigan Supreme Court as to why he should not lift a restraining order forbidding the unemployment compensation commission from payment of the benefits. Judge Carr kept the stay in force after his decision of June 12 in anticipation of the expected appeal to the state supreme court, which was filed July 11 by the Chrysler Corp.

The Michigan Unemployment Compensation Act provides for the immediate payment of benefits after a double affirmation of the claims, such as has been made by Referee Charles Rubinoff and Judge Carr. However, in seeking to have the stay remain in force, the corporation attorneys argued that it would be impossible to regain benefits paid out in the event the supreme court held that they were paid illegally. The constitutionality of the section of the act which provides for immediate payment of benefits never has been tested in the courts.

Crude Rubber Consumption Decreased 9.9% in June

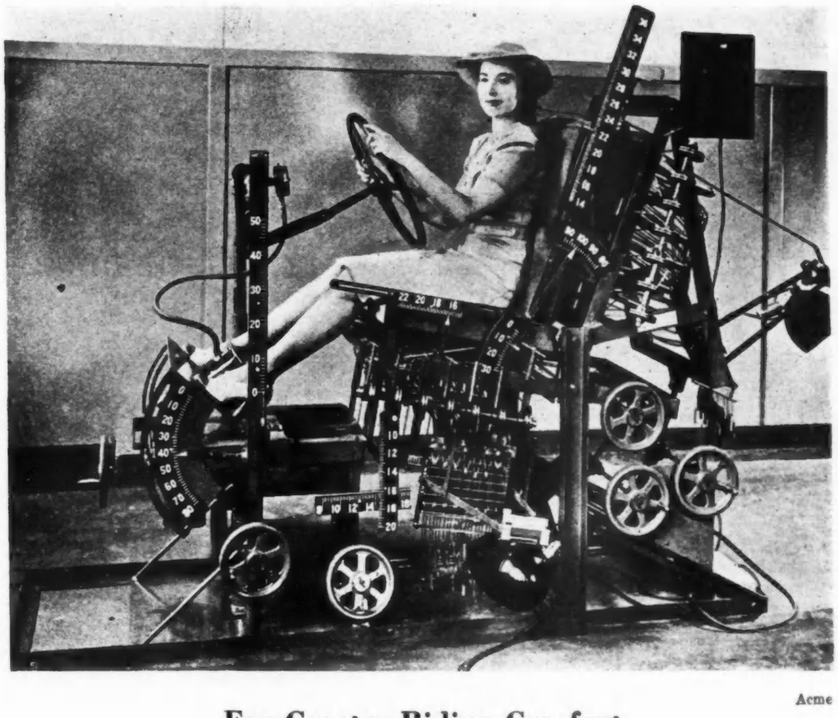
Statistics released by the Rubber Manufacturers Association, Inc., show that rubber manufacturers in the U. S. A. consumed an estimated 46,506 long tons of crude rubber during the month of June. This represents a decrease of 9.9 per cent under the May consumption of 51,619 long tons, and is four per cent below June, 1939, when 48,438 (revised) long tons were consumed.

Gross imports for June as reported by the Department of Commerce were 53,889 long tons, representing an increase of 4.8 per cent over the May figure of 51,431 long tons, and were 56.8 per cent over the 34,363 long tons imported in June, 1939.

Total domestic stocks are estimated by the Association as of the end of June to be 168,235 long tons, an increase of 4.2 per cent over the stocks on hand at the end of May which were 161,446 long tons, but three per cent under the stocks of 173,493 (revised) long tons on hand at the end of June, 1939.

Crude rubber afloat to United States ports on June 30, is estimated to have been 119,138 long tons, which compares with 109,364 long tons reported afloat as of the end of May, and 51,274 long tons afloat June 30, 1939.

Reclaimed rubber consumption for June is estimated at 15,844 long tons, production at 16,631 long tons, and stocks on hand June 30, 1940, at 28,327 long tons.



Acme

For Greater Riding Comfort

Engineers at the University of Michigan, Ann Harbor, Mich., use this intricate-looking device for automobile cushion research that has been sponsored for a number of years by the Murray Corp. of America. Weight distribution, spring tension and other data are recorded automatically by the machine

PUBLICATIONS

The line of **heavy-duty all-wheel drive vehicles** built by the Marmon-Herrington Co., Indianapolis, Ind., is the subject of a new pamphlet.*

Oakite Compound No. 32 for de-scaling Diesel and gas engine cooling systems is the subject of a booklet prepared recently by Oakite Products, Inc., New York.*

Thermometers and pressure gages (circular case) built by the Brown Instrument Co., Philadelphia, Pa., are described and illustrated in catalog No. 6705.*

The Standard Cost Subcommittee of the Rubber Manufacturers Association, New York, has prepared a supplement to its uniform accounting manual for the rubber manufacturing industry which is entitled "Standard Costs for The Rubber Manufacturing Industry."

More than 100 installations of "Caterpillar" **Diesel engines** are illustrated and described in a booklet, "On the Job," which has been issued by the Caterpillar Tractor Co.*

The Underwriters' Laboratories, Inc. has brought out a supplement to its December, 1939 list of **inspected gas, oil and miscellaneous appliances.**

A new bulletin published by Joseph T. Ryerson & Son, Inc., Chicago, deals with **cold finished steel bars** carried in stock for immediate shipment. Chemical analysis, working properties, suggested applications and other data are included.*

The Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, has prepared a revising supplement to the second edition of the handbook on the **Shipment of Samples and Advertising Matter Abroad.** It supersedes the 1935 supplement and takes account of all changes that have taken place during the last eight years. Copies of the basic handbook, Trade Promotion Series No. 72 (Revised), may still be purchased from the Superintendent of Documents, Washington, D. C., for $1. The new supplement is priced at 10 cents.

Cummins Engine Co., Columbus, Ind., has prepared a brochure that contains the latest data on its automotive **Diesel engines,** together with specifications on all models.*

The National Safety Council, Chicago, has issued its annual statistical report on **accident rates in the automobile industries.** The data presented covers the year 1939.*

The **"Parade of Plastics,"** a high-spot story of the origin of many plastic types, their characteristics, and many of their present uses, has been issued in pamphlet form by the plastics department of E. I. duPont de Nemours & Co., Arlington, N. J.*

Lighting units known as fluorescent troffers are described in a catalog issued by the Miller Co., Meriden, Conn., manufacturer of this equipment.

Pratt & Whitney, division of Niles-Bement-Pond Co., West Hartford, Conn., has distributed Vol. 1, No. 1 of "Backgrounds," a new company magazine that presents very attractively news of current progress in the use of tools, gages and "machines that build machines."

*Obtainable through editorial department, AUTOMOTIVE INDUSTRIES, Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

Ingot Output

(*Continued from page* 128)

stabilization may be affected by just such developments.

Copper, in the open market, sold at as low as 10½c. for spot electrolytic during the week ended July 27, but the large mine producers continue to quote 11½c. The dent that has been made into U. S. exports through the folding up of France is making itself more and more felt. Japan is now the only foreign customer left, Britain being self-contained in its copper supply through the South African dominions.—W.C.H.

Rules Issued for Certifying Costs of Defense Expansion

The Commissioner of Internal Revenue, together with the Secretary of War and the Secretary of Navy, have issued joint rules governing the procedure for certifying cost of additional equipment and facilities required for construction by private contractors of naval vessels and army and navy aircraft. The purpose of the certification is to determine excess profits payable to the Treasury.

Provision is made for four types of certification: certification upon estimated cost; supplemental certification; certification as to necessity, cost and percentage; and final certification as to percentage.

The rules said that it is not essential that special additional equipment and facilities be designed exclusively for any special type of work to be performed under the contract or subcontract or that the special additional equipment and facilities be adaptable

only for work required under the contract or subcontract. However, no certification will be made in the case of any item of additional equipment and facilities, which, in the absence of the contract or subcontract, would be reasonably necessary in the contracting party's operations. Certification will be made only at the proper request of the contractor. In the event a contracting party does not avail himself of the certification procedure, the government will presume that depreciation and obsolescence only is allowable as an element of cost.

Plans for Synthetic Rubber Production Crystallizing

Several processes for the production of synthetic rubber have been developed in the United States beyond the experimental stage to a point where plans for individual producing units are being engineered, according to Edward R. Stettinius, Jr., in charge of the Materials Division of the National Defense Advisory Commission. He told the press that a plan of synthetic rubber production is being worked out which in the future could eliminate United States dependence upon imports, which have been coming chiefly from the Malay Peninsula and the East Indies.

He said that when the Advisory Commission was appointed early in June it was felt that the problem of adequate rubber supplies was one of the most pressing. At the suggestion of the President a study of synthetic rubber production was made and conferences were held with each of the companies owning or controlling synthetic processes.

CALENDAR

Conventions and Meetings

National Institute for Traffic Safety Training, University of Tennessee, Knoxville ....Aug. 12-24
SAE West Coast Transp. & Maintenance Meeting, Seattle ....Aug. 16-17
National Industrial Advertisers Association, Annual Meeting, Detroit, Sept. 18-20
SAE National Tractor Meeting, Milwaukee ....Sept. 24-25
SAE Annual Dinner, New York......Oct. 14
American Society for Metals, Annual Meeting, Cleveland, Ohio....Oct. 21-25
American Welding Society, Annual Meeting, Cleveland ....Oct. 20-25
SAE Nat'l Aircraft Production Meeting, Los Angeles ....Oct. 31-Nov. 2
Aeronautical Chamber of Commerce of America, Inc., Annual Meeting, New York ....Dec. 5
National Association of Manufacturers, Annual Meeting, New York...Dec. 9-13
SAE Annual Meeting, Detroit, Jan. 6-10, 1941
National Automobile Dealers Association, Convention, Pittsburgh, Pa. Jan. 20-23, 1941

Shows at Home and Abroad

National Automobile Show, Grand Central Palace, New York........Oct. 12-19
Detroit Automobile Show........Oct. 12-19
Pittsburgh Automobile Show.....Oct. 19-26
National Metal Congress & Exposition, Cleveland, O. ....Oct. 21-25
Chicago Automobile Show....Oct. 26-Nov. 3
Automotive Service Industries Show, Chicago ....Dec. 9-14
Machine & Tool Progress Exhibition, Detroit ....Mar. 24-29, 1941

For the Army

Army officials have been testing this small car designed by Powel Crosley to carry four fully-equipped soldiers at a speed of up to 50 m.p.h. The vehicle is powered by a two-cylinder, air-cooled engine and is said to be capable of making 50 miles to a gallon of gasoline.

Acme

Japan Hit by Italy's Entry Into War and U. S. Rearmament

Her Machine Tool Industry Still Depends on Imports of High Precision Equipment

Two vaguely related international events apparently have thrown a monkey wrench into Japan's "material mobilization" program as well as into the Army's six-year armament replenishment program (started Apr. 1). One of them is Italy's entry into the European war on the side of Germany, and the other, the United States' rearmament.

Though her machine-tool industry has made substantial progress during the past few years, Japan is still dependent on imports for primary or master machine tools; special purpose tools, which could not be developed in Japan for lack of market; and particularly, high-precision machinery. Three-quarters of all Japanese machinery imports from the United States come under this last heading. Precision lathes, boring, grinding, hobbing and lapping machines of American make are prominent in every Japanese aircraft and automotive plant.

Several projects were based on the assumption that tools could be obtained from the United States or from Italy, including an expansion project of the Ishikawajima Shipbuilding Co.'s aero-engine plant, the 8,000,000-yen expansion plan of the Tokyo Automobile Co. (trucks, armored cars, tanks), the 30,000,000-yen International & Manchu Aircraft companies' aeronautical plants and the 100,000,000-yen Manchu Automobile Co.

Eighty-eight types of tools ordered by the Japanese in the U. S. have been held up under the Presidential ruling restricting export of machine tools. Only 15 have been released for shipment to Japan.

As regards Italy, that country did not count for much in Japan's automotive expansion program until Italy's adherence to the Berlin-Tokyo anti-Comintern pact. Following the outbreak of the European war, the Japanese pressed for closer cooperation, particularly in the aircraft field. With assistance from Germany, England and France unavailable and the U. S. tightening up on blueprints and engineering assistance, the Japanese were looking to Italy for help. Japan was fishing for a trade treaty, sent friendship missions to her anti-Comintern ally. An Italian firm pulled down a big order for machine tools, agricultural implements and tractors for delivery in Manchukuo, but the Italians balked at commitments on Japan's aircraft projects.

Last November, the Japanese Army had sponsored a 30,000,000-yen International Aircraft Co.; still earlier a 30,000,000-yen Manchu Aircraft Corp. International Aircraft, at least, had definite ideas about getting assistance from Fiat, Turin, famed makers of bombers and high-powered radial aircraft engines. It was shortly before Italy's entry into the war that Fiat came out with a reply: Japan had better order the equipment in the U. S. or in Germany. International planned to spend 45,000,000-yen on equipment, 6,000,000-yen on blueprints, licenses and foreign technicians, 10,000,000-yen on buildings, and 6,000,000-yen on the plant site.

Similar difficulties have prompted the two-year-old 100,000,000-yen Manchu Automobile Industry Co., which has yet to produce its first car, to buy out the equipment of the Nissan Automobile Co. The transfer is likely to be effected next Fall.

The Kongo Motor Co., erstwhile importers of Diamond T trucks, has be-

International

A Grandson Takes a Wife

Henry Ford, 2nd, grandson and namesake of the founder of the Ford Motor Co., and his bride, the former Anne McDonnell, shown with their parents and the monsignor who married them on July 13 at the Church of the Sacred Hearts of Jesus and Mary, Southampton, L. I. The bride's parents, Mr. and Mrs. James Francis McDonnell, are at the left. Mr. and Mrs. Edsel Bryant Ford, parents of the groom are at the right. Monsignor Fulton J. Sheen stands beside Mr. McDonnell

gun manufacture of a Japanese version of the vehicle, with Manchukuo as the principal market. The T40 type, of 1938, has served as model, it is stated. The Japanese replica has been named Kongo A. Electrical equipment is by Shibaura, the Japanese operating unit of International General Electric.

The Yamato Co., manufacturers of automobile and aircraft springs, has been authorized to increase its capitalization from 480,000 yen to 2,000,000 yen. A new plant is going up at Tsujido, near Tokyo.

The Toyota Automobile Co., one of the two dominant Japanese makers, has organized a subsidiary, Toyota Steel Manufacturing Company, which will in future supply the parent concern with special steels and rolled steel products.

LETTERS

Valuation and Tests of Electrical Indicators

Editor, AUTOMOTIVE INDUSTRIES:

I have read with interest Messrs. Fried and Schrader's comments on the paper "Valuation and Tests of Electrical Engine-Indicators" which appeared in AUTOMOTIVE INDUSTRIES of April 15, 1940, because I had translated the original article into Japanese by chance. At that time, I found a miss-translation, to which the fifth comment refers. That is to say, on page 373, it is stated that the coils work with currents of a few tenths to a few hundredths of a milli-ampere. But in the original paper, it ran as follows: Die Schleifen arbeiten dabei mit Strömen von einigen Zentel bis zu einigen hundert mA. Therefore, "a few hundredths" should be replaced by "a few hundreds." So there is no doubt that "mA" is milli-ampere, and with this correction made I am sure Messrs. Fried and Schrader would agree with the original author, Mr. Fritz Lichtenberger.

Another mistake occurs on page 372, where "30 cycles per second" should be "300 cycles per second," as in the original paper.

AKIRA MIYAZAKI,
Tokyo, Japan.

Aircraft Contracts Call For 25,000 Planes By July, 1942

Expansion of Facilities Could Be Written Off Against Profits In Five Years Instead of Ten Under New Amortization Scheme

More than $100,000,000 in Army and Navy aircraft contracts, previously reported as having been cleared by the National Defense Advisory Commission since June 3, have been withheld at the request of aircraft manufacturers pending the passage of a proposed amortization plan which would permit the writing off of new facilities in five years against profits rather than eight or 10 years under existing law.

The rough outline of the proposed amortization plan was announced at the White House on July 10 and contemplated that the plan would be incorporated in the new excess profits tax. That decision, made after conferences between Mr. Roosevelt and members of the defense commission, was interpreted generally as the go-ahead signal for plant expansions made necessary by defense orders, but since that time there has been considerable agitation for passage of the amortization plan without waiting for Congressional and Treasury Department tax experts to draw up an excess profits tax law.

Earlier, the defense commission, showing signs of being irked at persistent reports of an administration lag in converting Congressional appropriations into defense contracts with industry, had sent word out through its highly important aeronautics division that since July 3 more than $100,000,000 in aircraft contracts had been cleared through the commission; that additional contracts were in the mill under a well-planned two-year program expected to provide 25,000 planes by July 1, 1942; and that so far as its work relates to aircraft expansion "the next job in line is one for industry to handle."

In the first press conference to be held by an official of the defense commission, George J. Mead, former vice-president of the United Aircraft Corp., of Hartford, said that his division had been able to accomplish everything it set out to do and that its progress to date had been good considering "the magnitude of the task." He specifically mentioned the question of amortization, conceded it had been a serious "stumbling block" prior to the July 10 White House announcement, but apparently had reason to believe at that time that members of the aircraft industry would accept the contracts on the basis of assurances given by the White House announcement without waiting to learn further details of the amortization proposal.

The aircraft phase of the defense program, as described by Dr. Mead, shapes up like this:

The job, involving a hundred-fold increase over the air expansion program contemplated a year ago, is already on paper ready to go. Since conferences early this month with commission members, War and Navy Department officials and representatives of industry, more than $100,000,000 in aircraft contracts have been placed under a "well balanced" program involving the construction of only "proven types of equipment for large-scale production."

Contracts covering the balance of funds made available by Congress are now being negotiated under a new procedure approved by Congress to speed up the defense program by dispensing with the usual competitive bidding practices. It is expected that, including the $100,000,000 in contracts awarded since July 1, the program will result in the acquisition of 25,000 planes—about 17,000 for the Army and 8000 for the Navy—by July 1, 1942.

While the value of future design changes, incorporating improvements found essential in the light of experi-

Soviet Air Giant

This 40-ton plane, powered by six engines and capable of carrying 64 passengers and a crew of eight was placed in service recently by Soviet Russia between Moscow and Caucasian Spas. It is called the "USSR L-760." Four lounges aboard the ship are arranged for daytime use as a restaurant, library and seating accommodations. At night they are converted into sleeping compartments. Four other sleeping compartments, each for six persons, are located in the wings.

International

ence, is not being overlooked, the 25,000 planes will follow a "frozen" design, from which no deviation will be made. Engineering efforts will be concentrated on the basis of Army and Navy requirements but all "unnecessary" engineering work will be halted.

Defense experts are relying heavily upon the two large aeronautical laboratores to be maintained by the National Advisory Committee on Aeronautics. The work of the laboratory at Langley Field, Va., already has attracted world-wide attention. A new and larger laboratory is under construction at Sunnyvale, Cal., and, under a $8,400,000 appropriation contained in a recently-approved appropriation measure, a new laboratory to be devoted exclusively to aircraft engine engineering and development will be constructed at an undetermined location. This development is expected to put the country's aircraft engineering facilities on a par with those of Germany.

Both the Army and Navy, which heretofore have had their own construction and testing specifications, have agreed to a standardized procedure for handling contracts and to adopt uniform technical requirements. Greater standardization is the watchword for all materials going into aircraft construction, including stainless steel, finishes, final inspection and other details. Also being studied is the question of whether, as intimated in some quarters, the policy of aircraft designers in this country has been to make engine specifications for combat planes too rigid. In this connection, all factors bearing on the question of ways to speed up production are being thoroughly analyzed and whether tolerances will be relaxed in the interest of accelerating manufacturing methods without sacrificing sound engineering essentials is under close scrutiny.

Kentucky University Given New Engine Test Building

Gift to the University of Kentucky of a building to cost from $80,000 to $100,000, to be used as a testing laboratory for internal combustion and aeronautical engines has been announced by Dean J. H. Graham, head of the College Engineering. The donor was the Viking Foundation, headed by Axel Wenner-Gren, Swedish armaments magnate.

MEN . . . . . .

Carleton E. Stryker, formerly associated with Bendix Aviation, Ltd., Burbank, Calif., has been added to the headquarters staff of the Society of Automotive Engineers to take charge of the Society's national defense responsibilities in the establishment of standards pertaining to aircraft and aircraft-engine parts and materials. Prior to his association with Bendix, Mr. Strkyer had designed powerplants for the Aircraft Engine Co., Oakland, Calif.; was designer and engineer for the Airplane Development Corp., Glendale, Calif.; and then became chief engineer of the Curtiss-Wright Technical Institute of Aeronautics at Glendale. At one time he was consultant for the Aeronautics Branch of the Department of Commerce.

J. Russell Penman is now production manager in the Copperweld Steel Co.'s new alloy steel plant at Warren, Ohio.

G. Taylor Stanton has been appointed chief engineer of the TelAutograph Corp., New York. Mr. Stanton was formerly manager of industrial applications for Electrical Research Products, Inc., and designed the sound system in General Motors' Futurama at the New York World's Fair.

Howard R. Salisbury has succeeded **William W. Barnes,** retired, as manager at Philadelphia for the Air Reduction Co., New York. **H. B. Seydel,** formerly assistant sales manager of the New York district, has been named assistant manager at Philadelphia.

Lee D. Cosart has been appointed sales manager of the truck division, Dodge Brothers Corp. Mr. Cosart's appointment fills a vacancy created by the resignation recently of **T. W. Moss,** formerly director of Dodge truck sales.

John C. Sykora has been named general sales manager of the Gould Storage Battery Corp.

W. Leslie Lawrence has been elected secretary of the Alexander Milburn Co., Baltimore, Md. Mr. Lawrence succeeds Harvey H. Johnson who died on June 2.

Major James H. Doolittle has taken up duties with the Allison Engineering Co., Indianapolis, Ind., as liaison officer between the United States Army and Allison in the capacity of assistant supervisor for the army procurement division.

John H. Alfes has been appointed chief inspector of the Olds Motor Works, Lansing, Mich.

Louis J. Ouellette has been appointed sales supervisor of Dodge division, Chrysler Corp. Mr. Ouellette will share responsibilities with Dodge sales supervisor D. T. Stanton.

Thomas H. Corpe has been appointed assistant general sales manager of the Lockheed Aircraft Corp., Burbank, Calif. **S. W. Voorhes** has resigned from the position of assistant sales manager to take over Lockheed's eastern organization with headquarters in New York.

Alfred H. Geary has been named divisional manager in charge of the eastern division of Willys-Overland Motors, Inc., Toledo, Ohio.

J. Eugene Jackson has been appointed metallurgical engineer of the Copper Iron and Steel Development Association. Mr. Jackson's headquarters will be in Cleveland, Ohio.

J. Edward Trainer, general production manager of all Firestone Tire & Rubber Co. plants, has been elected vice-president of the company. Mr. Trainor continues with his duties as general production manager.

John P. Moran, vice-president in charge of production of Gemmer Mfg. Co., was recently elected to the presidency of the company, suceeding Edward P. Hammond, whose death occurred on May 28.

Harry J. Swanson, vice-president and treasurer of Ottawa Steel Products, Inc., Grand Haven, Mich., in charge of sales and engineering since 1924 when he became a stockholder and director, has sold his interest and resigned. Mr.

Estimated Dealer Stocks of New Passenger Cars

1939	January	February	March	April	May	June
Production—U. S. Domestic Market †	262,330	223,795	279,148	257,058	222,909	233,311
Retail Sales—U. S. ‡	180,692	165,865	276,364	265,992	276,719	254,604
Change in Inventory	+81,638	+57,930	+2,784	−8,934	−53,810	−21,293
Inventory, First of Month	237,393	319,031	376,961	379,745	370,811	317,001
1939 (continued)	**July**	**August**	**September**	**October**	**November**	**December**
Production—U. S. Domestic Market †	142,346	56,245	155,430	239,150	272,747	357,712
Retail Sales—U. S. ‡	229,873	166,172	139,222	236,584	257,398	274,233
Change in Inventory	−87,527	−109,927	+16,208	+2,566	+15,349	+83,479
Inventory, First of Month	295,708	208,181	98,254	114,462	117,028	132,377
1940	**January**	**February**	**March**	**April**	**May**	**June**
Production—U. S. Domestic Market †	348,755	324,555	341,634	351,814	315,441	......
Retail Sales—U. S. ‡	239,509	236,857	338,153	353,423	330,521	......
Change in Inventory	+109,246	+87,698	+3,481	−1,609	−15,080	......
Inventory, First of Month	215,856	325,102	412,800	416,281	414,672	398,592

International

He Came in First

Here is George C. Rand of New York who captured the second annual Montauk, L. I., Grand Prix automobile road race. Rand drove his Italian Maserati over the winding 62.7-mile course at an average of 61.19 m.p.h.

Swanson, who is a member of the Society of Automotive Engineers as well as the National Association of Cost Accountants, is taking a short rest before making any plans for the future.

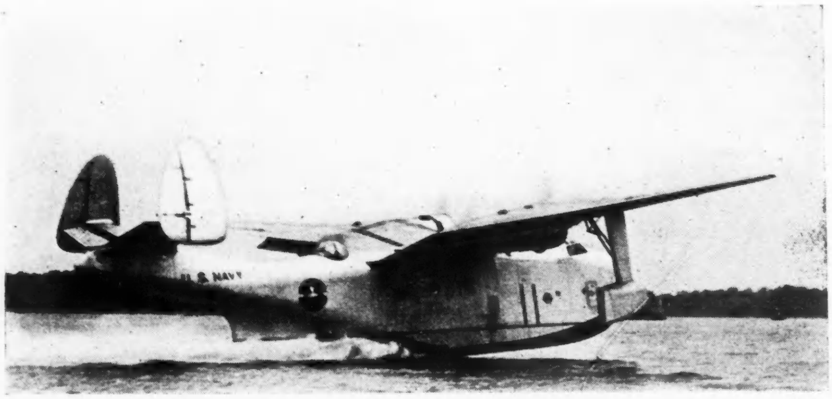
June Tire Shipments Heaviest Since 1932

Automotive tire shipments during June showed a gain over May of 17.5 per cent and were the heaviest for any single month since June, 1932, when 10,064,915 units were shipped, according to the Rubber Manufacturers Association, Inc.

Total unit shipments during June amounted to 6,718,761. This is 17.5 per cent over May, and is also higher than June, 1939, by 14.9 per cent. Replacement sales totaled 4,710,750 units, an increase of 29.6 per cent over the 3,635,652 units for May and 7.5 per cent above June, 1939, when replacements totaled 4,381,242 units.

Shipments for original equipment purposes amounted to 1,925,582 units, which compares with May shipments of 1,998,735 units. Original equipment shipments for June, 1939, were 1,368,891 units. Export shipments for June were 82,429 units which compares with 85,862 units for May and 98,875 units for June, 1939.

Production during June amounted to 5,127,384 units—a decrease of 5.3 per cent under May but 3.1 per cent over June, 1939. Stocks of automotive casings in the hands of manufacturers June 30 were 8,984,994 units, a decrease of 15 per cent under May 31 stocks but 4.1 per cent above stocks on hand June 30, 1939.



Acme

Newest for the Navy

The first of a fleet of long range patrol bombers being built by the Glenn L. Martin Co. for the U. S. Navy takes off from Dark Head Creek, Baltimore, Md. for a final test flight. The ship is designated as the Martin XPBM-1.

CENSORED

An exclusive feature prepared by the London correspondent of AUTOMOTIVE INDUSTRIES, *M. W. Bourdon.*

To relieve the monotony of continuous night shifts, a cabaret entertainment is being given at a number of plants during the mid-shift break. The scheme was tried out by the makers of B.S.A. cars (now fully occupied on war work) and its success has led to its being put into effect elsewhere.

* * *

L. P. Lord, formerly managing director of Morris Motors, Ltd., and latterly works director of the Austin Motor Co., has been appointed Government manager of the aircraft plant where the new "Defiant" fighters are being produced.

* * *

The Minister of Transport in a message to the Commercial Motor Users' Association emphasizes the need for truck operators to pay more attention than usual to the maintenance of their vehicles, for the reason that it is likely to become increasingly difficult, if not impossible, to secure new vehicles for replacement if and when old ones are allowed to become unfit for further efficient use.

* * *

Home sales of new cars in May amounted to only 12 per cent of the total of May last year. In April the percentage was 17; in June and onward it will probably fall gradually to nil owing to lack of material supplies, except for cars for export. Bus and truck sales in May numbered 284 and 1639, respectively (against 1257 and 5312). The May total of all motor vehicles, including motorcycles was 10,842 against 45,600 in May last year.

* * *

Geoffrey Burton, chairman of the Daimler Motor Co. and several associated firms, has been appointed Director-General of Tanks and Transport in the Ministry of Supply.

* * *

The Commercial Motor Users' Association is striving to assist operators in their search for replacement parts for their vehicles when manufacturers are unable to supply. Specified parts are sought in distributors' stocks, sometimes in distant parts of the country.

BOOKS . . . .

LE MOTEUR, TOMES I ET II, *by Henri Petit, editor-in-chief of "La Technique Automobile et Aerienne," and G. Mohr. Ninth edition. Published by Dunod, Editeur, 92 rue Bonaparte, Paris.*

This French elementary or popular work on the automobile engine has just appeared in its ninth edition. All recent advances in the design of engines are dealt with or at least referred to in the two volumes. Among new features not found in previous editions may be mentioned an extended discussion of supercharging, on modern combustion chambers and carburetors. Other chapters which were extensively revised include those on two-stroke engines, valveless (sleeve-valve) engines, and engine lubrication. Numerous new engravings and diagrams and an entirely new chapter on the principles of operation of the Diesel engine complete this two-volume work.

New Automotive Dictionary, Part I. English-Spanish. Compiled by the Lawyers' & Merchants' Translation Bureau. Published by G. E. Stechert & Co., New York.

This is a compilation of American and British terms used in the automotive and allied industries. It was compiled more particularly as an aid to those who have to translate trade literature and correspondence of the automotive industry into Spanish. The number of expressions for which Spanish equivalents are given is very large, and the arrangement is neat and convenient. The English term is printed in bold caps and is followed by the Spanish equivalent in lower-case type. In the case of less familiar or highly technical expressions, the Spanish equivalent often is followed by a brief definition. In addition to engineering terms, commercial terms used in the automobile industry and export trade also are included.

AUTOMOTIVE ENGINE TESTING, *by Foster M. Gruber. Published by Pitman Publishing Corp., New York.*

While a number of volumes on the testing of internal combustion engines have been published in the past, new methods and new equipment are constantly being introduced, and a new work on this subject is, therefore, to be welcomed. The material which forms the backbone of the text is that relating to experimental testing and the evaluation of the test results. The book, however, also contains a brief résumé of the operating principles of the internal combustion engine and an exposé of general engineering principles with which the test engineer should be familiar.

The first 130 pages of the book are given over to a general discussion of engine principles and of the properties of fuels and lubricants, in connection with which latter, equipment for fuel and oil tests and the methods of making such tests are described. The author then enters upon the principal subject of his work with a chapter on Test Equipment. This is followed by chapters on The Test Plant, Basic Computations, Test Routine, Analysis and Evaluation, Trouble Segregation, Special Tests and Instruments, and Balance and Vibration. The book covers practices in the testing not only of automobile engines but also of aircraft engines. The text is accompanied by 240 illustrations. Following the main text there are three appendices dealing respectively with Engine Test Forms, a Typical Engine Test, and Exercises, and finally there is a quite extensive bibliography on engine performance and engine tests.

Warner Aircraft Gets Order For 165 Hp. Super-Scarabs

Warner Aircraft Corp., Detroit, has received a $700,000 order for 250 Super-Scarab 165 hp. aircraft engines for installation in Australian training planes. The engine is a seven-cylinder, radial, air-cooled type. Final deliveries will be made in Australia next spring.

Clark's Twenty Acres

(*Continued from page 107*)

gears are shaved in the green on Michigan Tool equipment. For this purpose, they have a battery of three Michigan Tool rack shavers, one of these being the latest No. 900 heavy duty machine; and two of the new circular cutter shavers. To further assure "quiet" gear trains, all helical gears are lapped after heat treatment on a battery of five Michigan Tool lapping machines. This equipment is supplemented with a Red Ring lapper.

A battery of the familiar Type A Barber-Colman hobbing machine also is found here, principally for hobbing spline shafts and pinion shafts.

Among the new items of equipment in the machine shop are a number of Fay automatic lathes and the latest edition J & L turret lathes.

Quality of gear production is controlled by the gear laboratory which is provided with the conventional instrumentation including the latest type of Michigan involute checking machine.

A basement gallery houses the Gleason gear department in which are produced all of the bevel gears such as differential side gears and pinions, ring gears and axle drive pinions. Differential side gears and pinion blanks are produced on Cone automatic lathes. Prominent among the items of Gleason equipment in this department is a rather unusual machine—a Gleason ring gear grinder for finishing the large railcar hypoid ring gear.

After tracing their course through the machine shop and gear cutting departments, the gears and shafts wind up at a large terminal station where they are washed in a Niagara alkaline washing machine, filed and burred, then hung on a long monorail conveyor for transport to the heat treating department. If we follow the course of the conveyor, we reach the heat treat where the overhead line has been coiled and looped about itself so as to increase the developed length and thus serve as a storage conveyor as well.

The heat treating department is provided with modern equipment suited to the nature of the work. Among the principal items of equipment are a single and a double furnace for case carburizing, supplied by Electric Furnace Co.; one Surface Combustion propane mixture gas carburizing furnace; and two cyanide hardening furnaces which are used for certain gears made from SAE 5150 steel. They have a battery of four Gleason ring gear quenching machines, but due to the great variety of product, these machines are located in a separate corner and are served by an Electric Furnace Co. roller hearth furnace for reheating. Another interesting item of equipment is the battery of three Homo (L & N) drawing furnaces. Furnaces are individually controlled from a central panel room equipped with Micromax recorders.

Before the heat treated parts leave this department they are sand-blasted in a Pangborn machine.

It may be well to note at this point that the operations after heat treatment are concentrated in a separate part of the plant—another evidence of specialization. Here will be found the central grinding department with familiar items of equipment such as Norton grinders, Heald grinders, several large Heald double-end grinders, and a new Blanchard vertical surface grinding machine. In addition, there are several of the new Gear Grinding Machine Co. universal grinders for finishing the hobbed splines on transmission shafts and axle pinions.

Two separate lapping departments also are concentrated here. One is the Michigan Tool section for lapping helical gears; the other is the Gleason department for lapping ring gear and pinion sets.

Finished gears, regardless of type, are run in on the Gleason speeders and selected in matched sets which are suitably marked and wired together. This is the last operation before the gears

are packed for shipment to other plants.

An interesting application of special hard materials is found here in the use of Haynes Stellite Grade No. 6 rod for the hard facing of the working surfaces of hot shear blades and hot trim dies, greatly extending the useful life of such tools. Carboloy is used on cast iron and malleable iron differential casings for turning, facing, and miscellaneous operations on Gisholts and Sundstrand Stub lathes.

MEN and MACHINES

(*Continued from page* 118)

a part of the machine. The arrangement includes a vertical link which transmits motion to the cross feed pawl from either of the two crank mechanisms. Selection of feed for traversing or straight-in-feed grinding is made simply by connecting the link to the proper crank mechanism by means of a machine screw and hardened bushing fitting either of two holes in the link. The amount of feed per pick of the pawl is selected simultaneously by means of a pointer and a scale on the rotating member before the screw is tightened. Application of the arrangement increases the weight of the machine by approximately 15 lb.

A NEW portable AC welder designed for all around general utility service and production welding of every type has been announced by the Westinghouse Electric & Mfg. Co. Standard models operate either on 220 or 440 volts, are completely self-contained, and incorporate several new design features.

From 20 to 250 amp. of welding current is available in 27 current steps, with increments proportioned to meet the needs of welding with a wide variety of electrode types and diameters. A built-in "De-Ion" breaker protects against long sustained overloads, such as might occur by accidentally leaving the machine short circuited. This is convenient, too, for disconnecting the machine from the line without having to go back to a service or feeder switch. Open circuit or striking voltage is low, being of the order of 80 volts at 20 amp., and ranging down to 50 volts at the highest current rating.

The welder is furnished complete with all accessories, including welding helmet with lens, electrods holder, all leads, and a 17-lb. assortment of electrodes. Both a three-pronged plug and receptacle for the power lead is included.

THE Eisler Engineering Co., Newark, N. J., has developed a portable butt welder with a burr grinder and annealer mounted on a fabricated case which is portable. One of its many applications is in the repair of stranded wire, this unit being used to burn out (electrically) the faulty section and fuse all the strands, thereby preventing the ends from unraveling. The final steps are to butt weld the two ends and to grind off any burrs that may have appeared. The grinder has an adjustment to compensate for the wear in the abrasive and there are two bushings to guide the stranded wire to the grinder which squares off the ends to make neater butt welds. All wiring has been concealed within the fabricated case and a draft tube has been provided to remove grinding dust from the vicinity of the work.

The butt welder is supplied with a three KVA air-cooled transformer and an eight point variable switch for current regulation. The unit is foot operated and the butt jaws can be water-cooled for continuous service. Metals from 1/16 to 3/16 in. diameter can be welded. For butt welding other sizes of wire or metals, the units are available with transformers from 1 KVA up to 7½ KVA capacity.

AFTER several years of experimentation in its laboratories, the Mid-West Abrasive Co., Detroit, has devel-

oped an improved type of stone for Superfinish work and high-speed honing. Through the use of a new process all grains of abrasive in this stone are so bonded together that each grain is separate and acts as an individual polishing unit, thereby eliminating the possibility of several grains adhering and causing an uneven finish. It is claimed that the use of these stones permits absolute control of the depth of scratches in Superfinishing. Further, the company states, that because of this positive control and the fact that all shipments of stones are uniform, better and more satisfactory finish is assured.

ADDITIONAL new items of equipment announced in the past several weeks are, as follows:

Neilsen Tool & Die Co., Berkely, Mich.—Transfer screw and punch set which provides a new method for transferring screw and stud holes as well as blind drill holes from a drilled surface to another that is to be drilled in duplicate.

Ideal Commutator Dresser Co., Syramore, Ill.—No. 13 "Universal" electric etcher for permanently marking tools, parts, dies, bearings, saws, drills, products in production and finished parts. The device is recommended primarily for iron, steel and their alloys.

The Timken Roller Bearing Co., Canton, Ohio—New bearing series of the standard "SS" type. The first bearing in this series is designated as 9285-9220, with a cone bore of 3 in., O.D. of 6⅜ in. and width of 1 15/16 in. The 9100, 9300 and 90,000 series bearings of the "SS" type also have been redesigned to reduce outside diameters and widths of each series while still maintaining the same load carrying capacities. Two cone bores of 2 7/16 in. and 2 11/16 in. are available in the 9100 series. Two different bores of 3 in. and 5 5/16 in. are available in the 9300 series and one cone bore of 3 13/16 in. in the 90,000 series.

The Tannewitz Works, Grand Rapids, Mich.—Hydraulic two-wheel brakes for high-speed band saws which operate automatically to bring both wheels to a dead stop within an instant after saw breakage occurs, eliminating the hazard of a whipping broken blade.

Independent Pneumatic Tool Co., Chicago.—Portable "Thor" air grinder, No. 255. What is referred to by the company as a new "Air Behind the Blades" principle keeps the rotor blades of the grinder out against the cylinder wall, preventing any "dead center" position or the depression of the blades in the slots due to oil accumulation. This is said to assure positive starting.—H.E.B., Jr.

Machine Tool Index For June

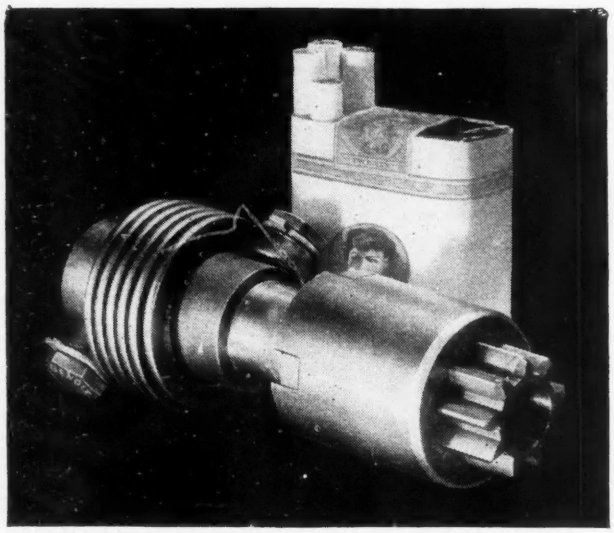
The operating capacity of the machine tool industry in June, according to the National Machine Tool Builders' Association, stood at 92.3 per cent of capacity, a slight decrease as compared with 92.5 per cent marked up in May. The association reports that the industry's capacity, measured in terms of payroll hours, is running about 27.5 per cent above September, 1939.

Publications Available on Machine Tools

The Harnischfeger Corp., Milwaukee, Wis., has issued a descriptive folder on its new P&H-Hansen WD-150 square frame **arc welder.** The WD-150, measuring less than 33 in. in length and one foot in height, delivers welding currents ranging from 200 down to 15 amp.*

Kearney & Trecker Corp., Milwaukee, Wis., has prepared a brochure entitled "Climaxing 42 Years of Building Milwaukee Milling Machines." Photographs, charts and text are combined to give an excellent "candid" glimpse of the company's personnel, management and production methods.*

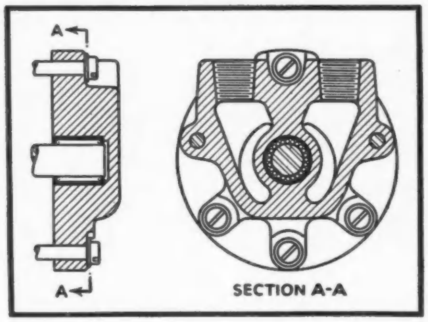
Data sheet No. 53, one of the newest released by the Gisholt Machine Co., Madison, Wis., describes performance achieved by a Gisholt 3L high production turret lathe on



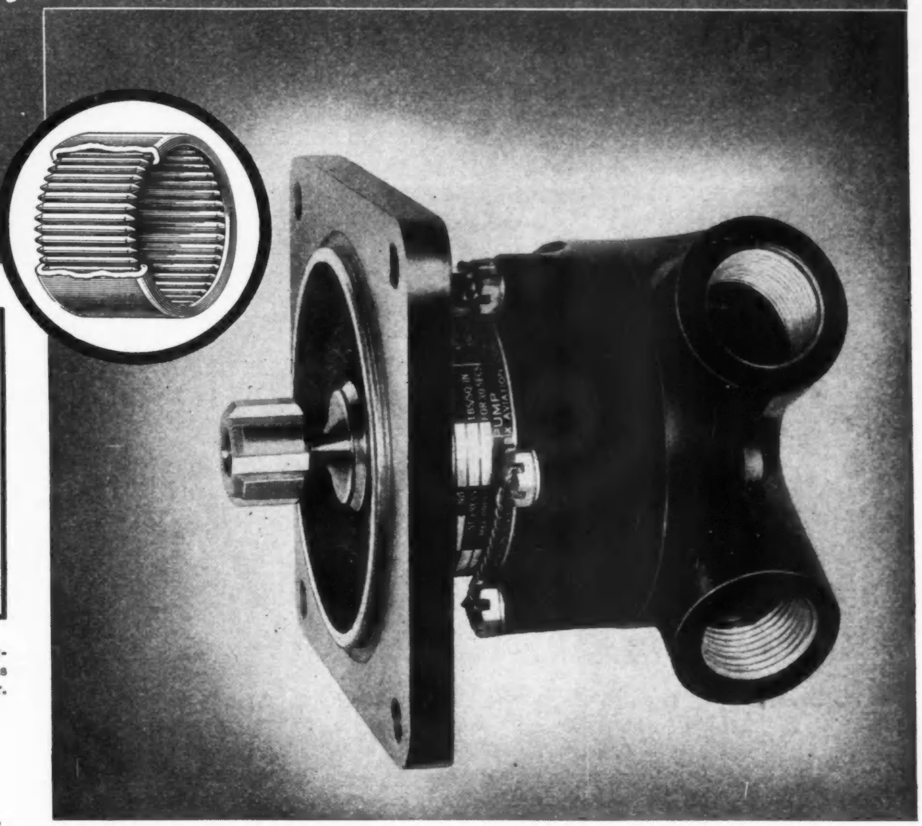
FOR ITS GEROTOR PUMP, ECLIPSE AVIATION SELECTS TORRINGTON NEEDLE BEARING

On 4 Counts

1. SMALL SIZE
2. LOW COST
3. HIGH CAPACITY
4. EASE OF LUBRICATION



(Above) **Cross-section showing installation of Torrington Needle Bearing between the cored porting holes of the pump. Here, space limitation was a vital factor.**



(Above) **MIGHTY MIDGET: Comparatively small in size and light in weight, this Gerotor-type ECLIPSE hydraulic pump is designed for operating pressures of 500 to 1000 pounds per square inch.**

ACTUATING wing flaps, wing tip floats, retractable landing gear, etc., on present-day giants of the sky is a job that requires Power—dependable, hydraulic power. That's why ECLIPSE AVIATION'S Gerotor-type Pumps are so generally specified as standard equipment in aviation circles.

Because of the weight and size limitations required for aircraft units, and as a result of service testing, design of the Eclipse Pump evolved the necessity for outboard bearing construction;i.e.,straddle type bearing supports—and since the design required location of the bearing between the cored porting holes of the pump, its diameter had to be kept to a very minimum—otherwise the port end of the pump would have to be greatly enlarged, with resultant added weight.

This problem was solved by the use of the Torrington Needle Bearing, which was selected for this application because of its compactness, low cost, ease of lubrication and availability to small tolerances on both the internal and external diameters. Further, since lubrication of the Needle Bearing was no problem, no special means of lubrication had to be provided. Hence the design was simplified.

Significant is the fact, that although several hundred pumps incorporating Needle Bearings have been built by Eclipse Aviation, no reports of bearing failure have been experienced. Of particular note is the fact that an Eclipse pump on life test, equipped with Needle Bearings, has run continuously for more than 1500 hours at 1000 PSI and 3000 RPM without indication of service difficulty.

Why not let the Torrington Engineering Department show *you* how the advantages of the Needle Bearing can be incorporated in *your* product designs. For information, write for Catalog No. 7. For Needle Bearings to be used in heavier service, request Booklet 103X from our associate, Bantam Bearings Corporation, South Bend, Ind.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Makers of Needle and Ball Bearings
New York Boston Philadelphia Detroit
Cleveland Chicago London, England

TORRINGTON NEEDLE BEARING

machining helical drive gear blanks for automotive trucks.*

Centerless lapping machines built by Cincinnati Milling Machine & Cincinnati Grinders, Inc., Cincinnati, Ohio, are described in a new publication, No. G-453.*

"Red Ring Automatic Precision Profiling" is the title of a folder brought out by the National Broach & Machine Co., Detroit.*

Bulletin No. 40 issued by the Eastern Machine Screw Corp., New Haven, Conn., describes H&G **solid adjustable die heads.***

Catalog No. 1845 published by Link-Belt Co., Chicago, covers the company's line of **flexible couplings.***

Printed copies of the first revision of Simplified Practice Recommendation R6, **Files and Rasps**, are now available, according to an announcement made by the Division of Simplified Practice, National Bureau of Standards. R6-40 may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for five cents each.

*Obtainable through editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

Production Aspects of the National Defense Program

(*Continued from page 96*)

our total national production. For example, assuming that the defense program results in expenditures of, say, four billion dollars during the next twelve months, this amount would represent only about 7 per cent of the estimated total outlay by consumers for the peacetime production of commodities turned out by the manufacturing, mining, agricultural and construction industries in a year such as 1937. And we must remember peacetime production adds to our real income; war production adds to our expense.

The point to be kept in mind is that this 7 per cent of our productive efforts devoted to defense work can be made less burdensome if the other more than 90 per cent is maintained active and at high efficiency. One can be superimposed on the other. Thus there is involved a double responsibility for industry. Increased employment, expanded manufacturing volumes, the maintenance of consumer buying power, renewed financial strength are all important elements in any program of national defense. Our internal economic defenses are the mainstay of our external defense.

America is the home of the machine. Here we have been able through the processes of industrial research and the intensive application of an ever-advancing technology to produce for ourselves more useful things and a greater supply of them than exist anywhere else in the world. The efficiency of our enterprises and the skill of our workmen and the resourcefulness of industrial management have importantly contributed to the strength and potentiality of this country. That is now being realized. I feel sure that, whatever the demands made upon American industry in this great program we are embarking upon, they will be met intelligently and aggressively. The task before us all is an important one requiring the utmost of understanding and the utmost of cooperation of which we all are capable. But time is an essential factor.

Synthane Builds New Press Room

Synthane Corp., manufacturers of Bakelite-laminated products, has just completed a new press room addition to its plant at Oaks, Pa. The first piece of equipment placed in operation was a new laminating press for handling special lengths up to 100 in.

Haynes Stellite Expands Its Plant At Kokomo, Ind.

Haynes Stellite Co., unit of Union Carbide & Carbon Corp., is expanding its manufacturing facilities at its plant in Kokomo, Ind., by the addition of a new 75 by 132-ft. factory building, a one-story structure of steel and brick with concrete floor and wide monitor top. Construction was started May 27 and it is expected that the building will be ready for use in August.